ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

VOL. XLI. No. 24.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....373, 387
A Curious Railway Trestle Failure (illustrated).... 374
American Locomotives for Foreign Railways (with two-page plate and other illustrations)..... 374
The New Chinese Railway from Canton to Hankow. 377
Through Transportation on Common Roads and Street Railways (illustrated)..... 378
Schenectady Locomotives for the Midland Ry. of England..... 379
A New Lock-Nut for Rail Joints (illustrated)..... 379
Telegraphing Across the English Channel..... 383
A New System of Valves for Steam Engines, Air Engines and Gas Compressors (illustrated)..... 384
The Difference Between Good and Bad Incandescent Lamps..... 384
The Allen Valve for Locomotives (illustrated).... 385
A Peculiar Grade Crossing (illustrated)..... 386
State Drainage Work in the Red River Valley, Minnesota..... 386
The Application of the Railroad Spiral to Race Tracks (illustrated)..... 387
Book Reviews..... 388
EDITORIAL NOTE..... 380
The Prospects of American Trade in China.
EDITORIALS:
The New Trans-Isthmian Canal Commission..... 380
Why Does the United States Build Locomotives for Foreign Railways?..... 381
LETTERS TO THE EDITOR..... 382
Annealing the Iron Cores of Transformers—Correction—The Proposed Dam Across the Rio Grande River at Elephant Butte, N. Mex.—More Concerning "Kalor"—Notes and Queries.

BIDS FOR A COMPLETE WATER-WORKS SYSTEM at Nicolaiev, Russia, are to be received from natives or foreigners until about Sept. 15. General specifications are published in "Advance Sheets of Consular Reports" for June 13, 1899, accompanying a communication from Mr. Thos. E. Heenan, U. S. Consul at Odessa. Water is to be developed by building galleries. The supply must be about 2,000,000 gallons per day, during 18 hours. Two compound condensing pumping engines, a water tower, 329,000 ft. of cast-iron pipe, hydrants and valves are required. The fire service must be such as to give from each hydrant a supply of 65 gallons per minute, thrown to a height of 70 ft. through a 3-in. hose. The contractor must operate the works for three years after completion, at a fixed annual rental. Mr. V. A. Datsenko is mayor of Nicolaiev.

PUBLIC IMPROVEMENTS AT NEW ORLEANS, on a large scale, were authorized on June 6 by a vote of 6,272 to 394, representing an assessed valuation of $36,390,000 for and $1,560,000 against the tax. The proposition was for an additional tax levy of two mills for 43 years (1899 to 1941, inclusive) to pay capital and other charges on the cost of providing a sanitary sewerage system, a complete drainage system and the purchase and improvement of the water-works. The present assessed valuation is about $139,000,000. It is proposed to continue the present levy for water-works and drainage purposes, and it is estimated that some $600,000 a year will be available at the start. Before anything final can be done both a legislative act and a constitutional amendment must be secured. There is talk of a special session of the legislature to further the project. An improved drainage system is already being constructed and water is furnished by the New Orleans Water-Works Co.

FOUR STEEL CARGO STEAMERS, 500 ft. long, will be built by the American Shipbuilding Co., the new consolidation of lake shipbuilding companies, to be delivered at the opening of navigation in 1900. It is stated that the new steamers will be the largest on fresh water, the next largest being the 490-ft. steamer of the Bessemer fleet contracted for delivery next season. The keel length of the four steamers will be 478 ft., with 52 ft. beam and 30 ft. molded depth. They will have quadruple expansion engines, cylinders 17, 25½, 39 and 60 ins. by 40-in. stroke. Steam will be furnished by water tube boilers, to be allowed 250 lbs. of steam. The boats will have 15 hatches and all the latest improvements. They will carry 8,000 tons on 18 ft. of water. The cost will be $350,000 each, or $1,400,000 for the four.

THE TORPEDO-BOAT "STRINGHAM," which the Harlan & Hollingsworth Co. is building for the United States Government, was launched on June 10. The "Stringham" is the largest and most costly torpedo-boat designed for the government, and on completion will be the pioneer of the ocean-going boats of her class. Her guaranteed speed is 30 knots an hour. The construction of the vessel was authorized in March, 1897, and the following July the contract was awarded. Her keel was laid on March 21, 1898. Her length is 225 ft., breadth 22 ft., mean draft, 6. ft. 6 ins., and displacement 340 tons. This is 70 tons more than the "Farragut," and twice as large as any other American torpedo-boat built or building. She will have two vertical triple-expansion engines of 7,200 HP. combined, which is greater than that of the cruisers "Detroit" and the "Montgomery," 2,000-ton ships, and nearly twice as great as that of the "Atlanta," and the "Boston." The "Stringham" will have a bunker capacity of 120 tons of coal, which will enable her to steam straightaway over 1,000 knots. Her armament will consists of two 18-in. Whitehead torpedo tubes and seven 6-pdr. automatic guns, and will be fought by a complement of four officers and twenty-eight men. The vessel is named for Rear-Admiral Silas Horton Stringham, who died in Brooklyn at the age of 78 years, after a service of sixty-seven years in the Navy, starting at the age of eleven as a midshipman.

THE YACHT "COLUMBIA," which it is expected will race with the "Shamrock" this fall, was successfully launched at Bristol, R. I., on June 10. The "Columbia" was built by the famous boat builder, "Nat" Herreshoff, and while the exact dimensions of the vessel are not known, it is understood that she is about 133 ft. long from stem to stern, with a 24-ft. deck beam, a depth from deck to keel of 25 ft., and a draught of 20 ft. 3 ins. Her keel is estimated to be 29 ft. long and to contain 95 tons of lead.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Norfolk & Western Ry., near Suffolk, Va., on June 9, as a result of a wash-out of a bridge over Kilby Lake. It is understood that the bridge failed as a freight train was passing over it, and that the locomotive and eight cars were thrown into the lake. Three men were killed.

A SERIOUS RAILWAY ACCIDENT is reported to have occurred on the Kansas City, Pittsburg & Gulf R. R., about three miles south of Grand View, Mo., on June 8, in which 45 persons were injured, three perhaps fatally. The accident is attributed to spreading rails, which derailed a south-bound passenger train with the results mentioned.

A TORNADO IS REPORTED TO HAVE KILLED between 200 and 250 persons in and around Hastings, Minn., on June 12. The towns of Hastings, Minn., Hudson and New Richmond, Wis., and other smaller places are reported either completely destroyed or badly damaged.

THE ORDNANCE WORKS of the Armstrong-Whitworth Co., at Newcastle-upon-Tyne, were destroyed by fire on June 11. The loss is estimated at $1,000,000.

REMOVING A HAMMER FROM AN ARTESIAN WELL by means of an electro-magnet was recently successfully accomplished near Belmar, N. J. The well was being drilled for the Spring Lake, N. J., Water-Works, and had reached a depth of 262 ft. Somehow the head of a 1-lb. hammer dropped into the well and resisted all usual methods of removal. Finally a special electro-magnet was wound and lowered by means of two No. 14 rubber covered wires. A small dynamo for furnishing the necessary current was set up and run by the drilling engine.

A FIRE TEST OF COTTON BALES of three different forms was made at Lowell, Mass., on June 9. The forms of bales tested were: the round or cylindrical bale of the American Cotton Co., which was described in Engineering News of Dec. 16, 1897; the Lowry bale of the Planters' Compress Co., and an ordinary square bale. The test was conducted by the Associated Factory Mutual Fire Insurance Companies of the United States. Two small frame houses exactly alike were constructed about 100 ft. apart. Each was built at an elevation of 2 ft. from the ground. The space beneath the houses was filled with dry boards and cotton waste, over which ten gallons of kerosene were poured. In one house eight American round-lap bales and one square bale were stored, in the other eight Lowry bales and one square bale. The combustible material under the houses was ignited at 1:35 o'clock. The flames burned for one hour, and entirely consumed the houses. Sprays of water were then turned on and the flames extinguished. When the superstructure of the houses collapsed the square bale stored with the American bales fell to the ground and beyond reach of the flames. Soon afterwards, in order to equalize the conditions, the other square bale was removed from among the Lowry bales. As they had burned only a few minutes, it was agreed that the square bales had not been subjected to the same severe test as the round. The bands of one of them had burst, however, and long after it had been drenched with water it was examined and found to be burning inwardly. Nearly all the wires on the Planters' bale were burned off, and the bales elongated from 3 ft. 3 ins. to 6 ft. and over. This exposed the cotton in the Lowry bales to the flames, which were eating into the bales at many points when the fire was extinguished. Two of the Lowry bales broke in two, and were more badly burned than the others. The round bales neither unrolled nor extended in length, and only the outer surfaces exposed to the intense flames were burned. The cotton saved from the fire will be carefully picked over, and the salvage reclaimed will be accurately weighed.

AN ELEVATED CYCLEWAY between Los Angeles and Pasadena, Cal., is now under construction by the California Cycleway Co. It is expected that two sections will be completed by next December. The structure will be nine miles long, 10 ft. wide, elevated from 4 to 50 ft. above the ground, and will be composed almost wholly of Oregon pine (Douglas fir). There will be 800 ft. of steel bridges. The maximum grade will be 3% and the average grade 1¼%. It is proposed to light the cycleway with incandescent lamps, placed 200 ft. apart, with installation for lamps 100 ft. apart. An amusement park will be located half way between the two cities. The regular toll, as now proposed, will be 15 cts. for the round trip, with special tolls of 10 cts. The estimated cost of the scheme is $187,500. To make the cycleway and its stock popular, some of the latter will be offered at $20 per share, each share entitling the holder to an annual pass, with the privilege of transferring the passes where more than one share is bought. Mr. Horace M. Dobbins is President and Mr. W. R. Stevenson Secretary of the company, whose office at Pasadena. The above information was furnished this journal by the company, at our request.

A MOTOR-CYCLE RACE lately took place at the Crystal Palace, in London, under the auspices of the Motor Car Club. Four motor cycles entered for the 5-mile race, all run by petroleum engines. The men pedaled at the beginning until the motors were in full operation, and then only attended to steering and regulating the taps. The five miles were made in 8 m. 22 3-5 s., or at the rate of about 37¼ miles per hour. The ordinary bicycle record for the same distance is 8 m. 47 1-5 s.

A GASOLINE ENGINE MOTOR CAR, which has recently been built, is equipped with the Reeves variable speed gear. A three-cylinder vertical gas engine of 45 HP. is mounted on a four-wheel truck frame, together with the variable speed gear, which is driven by a belt from the engine, a clutch enabling the gear to be thrown in or out of action as desired. The Reeves gear consists of two parallel shafts, one above the other, with two conical pulleys on each shaft, and these pulleys can be traversed along their shafts. Between the two sets of pulleys runs a belt so made as to be very stiff transversely, transmitting motion from the driving to the driven pulleys by the friction of its edges. As the pulleys on one shaft are drawn apart those on the other shaft are brought closer together, so that the distance between the bearing surfaces remains constant. The driven shaft is connected with the truck axle by gearing. This driving truck forms the front truck of a 21-ton car, 41 ft. 6 ins. long. The engine was made by the Wolverine Motor Works, of Grand Rapids, Mich.; the variable speed gear by the Reeves Pulley Co., of Columbus, Ind., and the car by the Jewett Car Co., of Jewett, O. The car can be run at speeds of 25 to 30 miles per hour, and is intended for local or suburban service on main lines. It is owned by the Vimofum Hydrocarbon Car Co., Great Northern Building, Chicago.

THE PRALL SUPERHEATED WATER MOTOR is being experimented with by the New York Central Ry., with the idea, it is said, of adopting it as a motive power to haul all trains from High Bridge to the Grand Central Station, New York city. This motor, it will be recalled, is a steam engine carrying a reservoir containing water which has been heated up to 600° F., and which gives off steam as the pressure is lowered.

THE REFRIGERATING PLANT AT MANILA is to be built by the De La Vergne Co., of New York, for $197,000, under a contract with the government for the machinery. The plans call for main refrigerating rooms 48 × 128 ft. by 10 ft. clear height. The capacity contracted for is cold storage for 1,200 tons of beef, 200 tons mutton, 100 tons potatoes and onions, 50 tons butter and an ice-producing output of 40 tons in 24 hours. The entire cost of the plant will be about $500,000.

A PNEUMATIC SAFETY JAIL is the name of a recent novel application of compressed air which has been developed and is about to be placed on the market by the Pneumatic Safety Vault & Jail Co., of Chattanooga, Tenn. The walls of the vaults or cells are steel tubes spaced about 4½ ins. apart, and the floor and ceiling are of double steel plates with an air space between. These tubes and air spaces are all in communication and are kept filled with compressed air. In case the bars are cut in an attempt to escape, the reduction in the air pressure at once sounds an automatic alarm at any desired point. The door is also built up with air tubes, and the lock is also protected by a hollow hinged bar swinging across its face. This must be removed before the lock can be gotten at. The tubes contain in their interior, octagonal bars about ⅞-in. diameter of hardened tool steel. These are pivoted at the ends, and readily turn, so that even if the air pressure were removed, the cell would be as difficult to escape from as any other now on the market. The enterprise is backed by the Casey & Hedges Mfg. Co., of Chattanooga, makers of boilers and machinery. Mr. Linn White, C. E., will be the busines manager of the new company.

A CURIOUS RAILWAY TRESTLE BRIDGE FAILURE.

The collapse of a timber trestle under an ore train on the Belt Line branch of the Great Northern Ry., between Saunders and Allouez Bay, near Superior, Wis., was briefly noted in our issue of May 11, 1899. As stated at that time, the accident occurred on May 8, and resulted in the death of the locomotive engineer, and the serious injury of the fireman, besides the nearly complete wreck of the trestle and the train of 40 loaded ore cars and several box cars and the locomotive which was hauling them. The peculiarities of the wreck were that all but 300 ft. of the 1,200-ft. trestle fell, carrying all but the three rear cars of the train with it, and that the whole train, except the locomotive, which struck on its rear end, landed on the ground 98 ft. below right-side up on the trucks, with the track beneath, and not so very greatly disturbed in alinement and level. These features of the wreck are excellently displayed in the three half-tone views which we present herewith.

The trestle which failed was 1,200 ft. long and 98 ft. high, and crossed the valley of the Namadji River, the river span proper being a combination wood and iron truss span, and the remainder of the structure being made up of timber trestle bents two stories high. Fig. 2 shows the river span standing, with the wrecked trestle-work beyond. On this span, as shown by Fig. 2, stand the three cars, which alone out of the whole train did not fall into the valley below. These were the rear cars of the train, the forward end of which is shown by Fig. 1. The tender, it will be seen, fell right-side up and almost "in its tracks," so to speak; but the locomotive seems to have landed squarely on the rear end of its cab, from the splintered woodwork of which was taken the body of the dead engineer. The trestle seems to have sheared off at a point just under the engine, as cleanly as if it had been cut with a knife. Between the locomotive at this end and the wrecked box cars at the opposite end, lie the 40 loaded ore cars, as shown by Fig. 3. This view shows the temporary track which was employed in removing the wreckage, laid alongside the fallen cars.

The almost vertical fall of the wrecked train is clearly indicated by the views which are shown. In alinement the position of the wrecked cars hardly varies, except for the rear box cars, from the axial line of the bridge. Some of the newspaper accounts of the accident also stated that all but a few of the wrecked ore cars remained with their wheels squarely upon the rails. This indicates that the trestle collapsed so evenly along its whole length that the falling track remained practically level, and the same thing is also indicated by the fact that the ore cars were found with their underframes broken transversely across about midway between the trucks. Supposing the cars to land on both trucks at once, this is exactly the point at which they would naturally break under the weight of their loads.

Beyond this apparently even collapse of the trestle, which would seem to indicate general and uniform weakness, there appears to be very little evidence regarding the cause of the failure. The original newspaper story that the water had undermined the trestle is not a very probable explanation, for the reason that the water had apparently fallen below the foundations of the trestle bents some time previous to the failure, and the structure had been safely crossed by numerous trains between that time and the date of the accident. The witnesses before the coroner's jury gave no evidence upon which a theory of the accident could be based except that they all testified to the sudden and general collapse of the structure, which has already been mentioned as being indicated by the position of the wrecked train. The verdict of the coroner's jury fixed no responsibility for the accident.

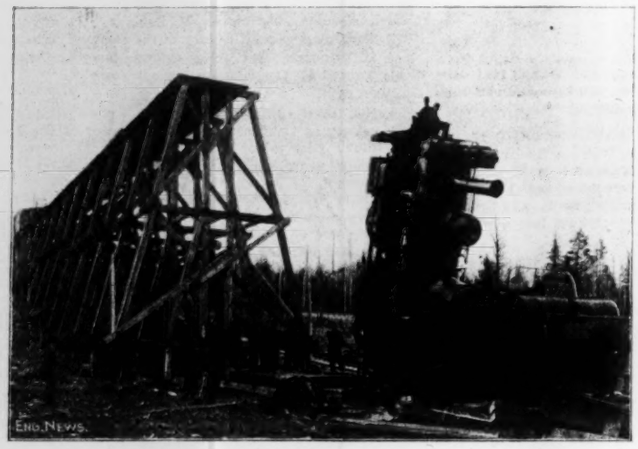


FIG. 1.—VIEW OF WRECK AT FRONT END OF TRAIN.

FIG. 2.—VIEW OF WRECK AT REAR END OF TRAIN.

FIGS. 1 AND 2.—VIEWS OF WRECK CAUSED BY THE COLLAPSE OF A 1,200-FT. TIMBER TRESTLE, 98-FT. HIGH, OVER THE NEMADJI RIVER, NEAR SUPERIOR, WIS., GREAT NORTHERN LINE.

AMERICAN LOCOMOTIVES FOR FOREIGN RAILWAYS.

(With two-page plate.)

The American export trade in locomotives has now grown to such proportions, and American locomotives are in service in so many foreign countries, that it appears worth while at this time to present to our readers some detailed information on the subject, especially as the great extent to which American locomotives are now in service on foreign railways is not fully realized even in this country.

From ten out of the twelve large locomotive building firms in this country we have received direct returns respecting their export business for the year 1898, which we have tabulated below. Two of the firms reporting built no engines for export:

Name of builder.	No. of Locos. for export.	No. of countries supplied.
Baldwin Locomotive Works	348	20
Schenectady Locomotive Works	71	2
Brooks Locomotive Works	43	2
Richmond Locomotive Works	32	2
The H. K. Porter Co.	26	3
Rogers Locomotive Works	25	6
Pittsburg Locomotive Works	13	2
Dickson Locomotive Works	10	3
Total	568	..

In our editorial columns in this issue we have discussed the general causes which have led to the growth of the locomotive export trade. In the present article it is our purpose to give some idea of the extent to which American-built locomotives have been introduced in the principal foreign countries, and to illustrate and describe some notable examples of these machines. The leading dimensions of the engines illustrated are given in the table on page 376.

FIG. 3.—VIEW OF WRECKED TRAIN, SHOWING ALINEMENT OF THE FALLEN CARS.

Europe.

England.—The first modern order from England came in 1898, for a small side-tank engine for a narrow gage line (1 ft. 11½ ins.). It was guaranteed to haul 50 tons up a 2% grade, 14 miles long, at a speed of 20 miles per hour. The Baldwin

and Schenectady works are now building about 60 mogul freight engines for three of the leading English trunk lines, while the Cooke Locomotive Works, Paterson, N. J., is building tank freight engines for two other roads. One of the Baldwin freight engines was illustrated in our issue of May 4, 1899.

France.—The French State Railways have placed an order for ordinary locomotives, while the electric locomotives for the Paris underground terminal extension of the Orleans Ry. are now under construction.

Spain.—Some 43-ton consolidation engines for the La Robla & Valmaseda Ry. (meter gage) were built last year, and one of these engines is shown in Fig. 1. It is a consolidation simple engine, with straight boiler and extension smokebox. The guides are of the Laird pattern, and all the rods are of I-section. The tender is of the ordinary eight-wheel pattern. The engines are guaranteed to haul a load of 160 tons up a grade of 2½%, combined with curves of 14.5°. They were built by the Baldwin Locomotive Works, Philadelphia, Pa.

Norway.—The State Railways (3 ft. 6 ins. gage) have been supplied with 23-ton eight-wheel passenger engines (Eng. News, Sept. 24, 1896), and 24½-ton mogul freight engines, while the Holand Ry. (2 ft. 5½ ins.) has 21½-ton suburban tank engines, with six coupled wheels and leading and trailing pony trucks. One of the eight-wheel engines for the State Railways is shown in Fig. 2. It has a straight boiler, with a short smokebox and an unusually high dome. The tender is mounted on a four-wheel trailing truck and a single leading axle, the latter being carried in pedestals on the frame. These engines were built by the Baldwin Locomotive Works, Philadelphia, Pa.

Sweden.—Mogul engines of 34 tons weight were built in 1892 for the State Railways (4 ft. 8½ ins. gage). At present 10 ten-wheel two-cylinder compound engines (with six-wheel tenders) and 10 six-wheel tank engines are being built for these lines by the Richmond Locomotive Works. Their leading dimensions are as follows:

	Ten-wheel engines.	Tank engines.
Driving wheels	5 ft. 2 ins.	4 ft. 0 ins.
Wheelbase, driving	12 " 8 "	12 " 0 "
" total	23 " 3½ "	12 " 0 "
Weight on drivers	89,000 lbs.	72,000 lbs.
Weight, total	121,000 "	72,000 "
Cylinders, h. p.	20 × 24 ins.	15 × 22 ins.
" l. p.	30 × 24 "	.....

Denmark.—The Sydfyenske Ry. (4 ft. 8½ ins.) has been supplied with four-wheel, 23-ton, saddle-tank switch engines.

Finland.—In 1898, 17 compound mogul engines were built for the State Railways (5 ft. gage), by the Richmond Locomotive Works, Richmond, Va. Ten-wheel, 45-ton pasenger engines of American design, and small Forney engines, have also been sent to Finland, as well as some 10-ton saddle-tank engines for the Nykarleby Ry. (1 ft. 11⅝ ins.).

One of the mogul engines is shown in Fig. 3, and its design illustrates what we have pointed out in the editorial in another column, to the effect that American builders are as ready to work to foreign plans as to home designs. The engine is almost identical with engines built in Europe for these railways, with the exception that it has the Richmond two-cylinder system of compounding. It has a straight boiler, with dome and sandbox, and a balloon stack. The piston rods are extended through the front cylinder covers, and the crossheads have single-bar guides. All the rods are of I-section. The cab is of steel, and on its roof are mounted the whistle and bell, with the German steam bell-ringer described and illustrated in our issue of Sept. 21, 1893. The four-wheel tender has the axle boxes carried in deep plate frames.

Russia.—For several years past American builders have been supplying locomotives to Russia in large numbers. Most of the railways are of 5-ft. gage, and the engines range from six-wheel tank switching engines and 50-ton Forney engines, to 65-ton consolidation and ten-wheel engines, both simple and compound. The tenders of many of these engines have tanks for oil fuel, and one of the tank engines was illustrated in our issue of Sept. 24, 1896.

The ten-wheel engine for the Moscow, Kieff & Voronesh Ry. (5 ft. gage), which is shown in Fig. 4, is a good representative of a number of engines built for Russia. It is a Vauclain four-cylinder compound, with a straight boiler and extension smokebox. The rods are of I-section. Two peculiar features are the hand-rails along the running boards (which are required by law) and the cab on the tender, with doors at the side of the tender deck. The tender is of the ordinary eight-wheel pattern. The engine is one of several built by the Baldwin Locomotive Works, Philadelphia, Pa.

Asia.

Palestine.—The Jaffa & Jerusalem Ry. (meter gage) has 27-ton mogul engines, hauling 165 tons up 2% grades.

India.—The pioneer American engine is a four-wheel, six-ton, saddle-tank engine of 3 ft. gage, which was sent out by the Dickson Locomotive Works last year, but the Baldwin works are now building a number of locomotives for ordinary railway service on lines of 5 ft. 6 ins. and meter gage.

FIG. 9.—MOGUL TANK ENGINE; IGA RY. (JAPAN).
Pittsburg Locomotive Works, Builders.

China.—The first American locomotive for China was built in 1887. Since then, several engines of different types have been built, and others are now under construction. The latter include 12 eight-wheel engines of 58 tons, 4 moguls of 65 tons, and 4 tank switching engines of 45 tons, for the Imperial Railways of North China (4 ft. 8½ ins.). A 56-ton tank engine for the Sung-Wu Ry. was illustrated in our issue of Sept. 9, 1897.

A mogul engine for the Lu Han Ry. (4 ft. 8½ ins.) is shown in Fig. 5. It has a Belpaire firebox, and the boiler has a somewhat strange appearance from the fact that the sandbox is not placed on top, as in ordinary American practice, but is placed underneath the front end of the boiler barrel, having lids at the ends of the running boards. Two-bar guides, with alligator crossheads, are used, and the rods are of I-section. It will be noticed that the engine is equipped with the M. C. B. coupler, which device is used on most of the railways in China. The tender has six wheels, with the axles carried in pedestals attached to the frames. This engine was built by the Rogers Locomotive Works, Paterson, N. J.

A consolidation engine for the Chinese Eastern Ry. is shown in Fig. 6. This line is the extension of the Trans-Siberian Ry. and is being built and equipped by Russia, having the Russian standard gage of 5 ft. The engines are both simple and compound (the latter being on the Vauclain four-cylinder system), and engines of almost identical design (but without the cab on the tender) have been built for Russian railways. It will be noted that the low-pressure piston-rod is extended through the front cylinder cover. A short balloon stack is used, and hand-rails and a cab on the tender are fitted. The tender is of the eight-wheel type. These engines were built by the Baldwin Locomotive Works, Philadelphia, Pa., and they have also built six-wheel tank engines for the same railway.

Japan.—Nearly all the American builders have had a share in the extensive orders from the government and private railways. The engines include eight-wheel passenger engines (Eng. News, Feb. 3, 1898), suburban side-tank engines, switching engines and 47-ton consolidation engines. All of the railways are of 3 ft. 6 ins. gage. Compresed air locomotives for use in coal mine workings have been supplied by the H. K. Porter Co., of Pittsburg, Pa., and tank engines have also been supplied for the railway on the island of Formosa.

A handsome eight-wheel passenger engine for the Hankaku Ry. is shown in Fig. 7. It has a wagon-top boiler, with extension smokebox; four-bar guides, and rods of I-section. The cab is of steel, of a design extensively used by the builders, but it is placed low down, so that the driving wheels project through the cab and running board, being covered by hoods or splashers. The six-wheel tender has its axles carried in pedestals bolted to the frames, the construction being as shown in our issue of June 9, 1898. The screw couplings, spring buffers and small marker lamps are foreign-looking features. The engine was built by the Brooks Locomotive Works, of Dunkirk, N. Y.

A heavy consolidation freight engine for the Kiushiu Ry. is shown in Fig. 8. It has a straight-top boiler, extension smokebox, Laird guides, and rods of I-section. The fittings include spring buffers, and "knives" to knock small obstructions off the rails. The tender has a four-wheel trailing truck and a single leading axle carried in pedestals on the frames. The engine was built by the Schenectady Locomotive Works, Schenectady, N. Y. The same firm has this year built 12 eight-wheel engines for the same railway. They are for passenger and freight service, and have 54-in. driving wheels and cylinders 16 × 24 ins. The weight is 39½ tons, with 26 tons on the driving wheels.

An engine of different type is the mogul tank engine for the Iga Ry., Fig. 9, which was built by the Pittsburg Locomotive Works, Pittsburg, Pa. It has side tanks, a rear coal bunker and an enclosed cab, the side tanks being more in accordance with European than with American practice. It has spring buffers and the English type of screw coupling. The engine is representative of a great number of engines built by most of the builders in this country for various Japanese railways. Some fine looking 44-ton side-tank engines have been built at the Schenectady Locomotive Works for suburban service on the Nippon Ry. They have four coupled 56-in. wheels (of which the rear pair are the main drivers), leading and trailing pony trucks, and cylinders 14 × 22 ins.

Korea.—The first railway in this little kingdom was built in 1898, and is equipped with 39-ton mogul tank engines, of standard gage (Eng. News, Feb. 24, 1898).

Hawaiian Islands.—The Oahu Railway & Land Co. has its road (3-ft. gage) equipped with 31-ton ten-wheel and 33½-ton consolidation engines (Eng. News, June 30, 1898), while 9-ton saddle-tank engines have been built for agricultural lines of 2-ft. gage.

Africa.

Egypt.—The Egyptian Government Railways (4 ft. 8½ ins.) have 45-ton Baldwin mogul freight engines: driving wheels, 60¼ ins.; weight on drivers, 38 tons; cylinders, 18×24 ins. The tenders are of the English six-wheel pattern, with deep plate frames. These railways have also a large number of American steel freight cars.

Soudan.—For the Soudan military railway (3 ft. 6 ins.) built by Gen. Kitchener, the engines were ordered in this country on account of the promptness of delivery promised. They are of the eight-wheel type, and one is shown in Fig. 10. These engines are of special interest from the fact that they were ordered in America because English builders could not undertake to furnish them within the time required, and from the further fact that they will run over the Atbara bridge, built by an American firm, the Pencoyd Iron Works, Philadelphia, Pa. (Eng. News, May 18, 1899). The engines are of plain and simple construction, and in matters of detail have a somewhat unfamiliar appearance, having neither sandbox, bell nor headlight. Presumably the desert winds will spread all the sand upon the track that may be required. The boiler is of the wagon-top pattern, with extension smokebox. The tender is mounted on six wheels, the two rear axles being carried in a swiveling truck frame, while the leading axle is carried in pedestals on the tender frame. It has no coal space, but a tank for oil fuel, and weighs 25,000 lbs. empty. The engines were built by the Baldwin Locomotive Works, Philadelphia, Pa.

Cape Colony.—A passenger engine for the Cape Government Railway (3 ft. 6 ins. gage) is shown

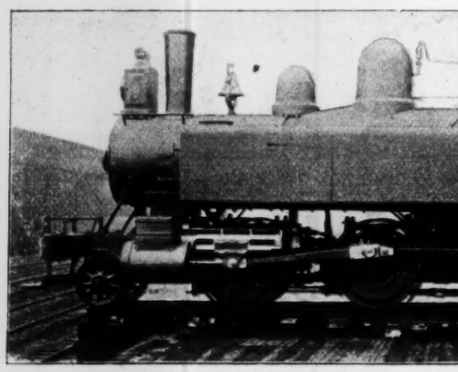


FIG. 12.—TANK ENGINE FOR A GOLD MINING COMPANY (SOUTH AFRICA).
The H. K. Porter Co., Builders.

in Fig. 11, from which it will be seen that the Atlantic type of engine, which originated in this country a few years ago, is now represented in this far-off British colony. The engine has a straight-top boiler, with extension smokebox and wide, deep firebox, the rear ends of the frames being dropped to receive the latter. It is fitted with the vacuum brake, and has an eight-wheel tender. In our issue of Oct. 28, 1897, we gave full dimensions of these engines, which were built by the Baldwin Locomotive Works, Philadelphia, Pa.

Transvaal.—Four-wheel saddle-tank engines have been sent to the Transvaal & Delagoa Bay Colliery Co.

British East Africa.—Locomotives are now being built in this country for the Mombasa & Uganda Ry. (meter gage).

South Africa.—The tank engine shown in Fig. 12 was built for the 36-in. gage lines of a large gold mining company. It has side tanks and a rear coal bunker, and is carried on six driving wheels, with a pony truck at each end. Laird guides are used and M. C. B. couplers are fitted at each end. It was built by the H. K. Porter Co., Pittsburg, Pa.

Australasia.

New South Wales.—In 1885, mogul engines were built in this country to colonial designs for the government railways (4 ft. 8½ ins.), and since then a number of 63-ton ten-wheel passenger and 69-ton consolidation freight engines (both simple and compound) have been sent out by the Baldwin Locomotive Works (Eng. News, March 12 and Sept. 22, 1892).

Victoria.—Six coupled tank engines for development lines of 2 ft. 6 ins. gage have been built for the Government railways. They have leading and trailing pony trucks; the simple engines weigh 34 tons, and the four-cylinder Baldwin compounds 35 tons.

Western Australia.—Engines of peculiar form, with six coupled wheels, a four-wheel leading truck and a two-wheel trailing truck, have been built for the lines of the Karri & Jarrah Forests Co. (3 ft. 6 ins.). They weigh 45 tons, and work on grades of 6%, with curves of 264 ft. Saddle-tank logging engines with four coupled wheels, leading and trailing pony trucks, and eight-wheel tenders, have been built for the same company.

New Zealand.—In consequence of unsatisfactory experience with English builders, orders were placed in this country in 1885 for twelve mogul (with trailing truck) passenger and consolidation freight engines for the Government railways (3 ft. 6 ins.). The conditions under which they were ordered were discussed in our issues of Sept. 5 and Dec. 5, 1885; Nov. 14, 1891, and Jan. 26, 1893. All the engines were shipped within five months, and their successful performance brought further orders, including tank and passenger engines with six driving wheels and a pony truck at each end, and also 32-ton consolidation freight engines. In Fig. 13 is shown one of a number of ten-wheel engines built last year by the Baldwin Locomotive Works, Philadelphia, Pa. It has a straight-top boiler, with Belpaire firebox and extension smokebox. The piston rods are extended through the front cylinder covers, and have deep crossheads with two-bar guides. An iron pilot is used, and on the bumper beam will be noticed the combined central coupler and buffer which is extensively used on narrow gage colonial railways. The tender is of the eight-wheel type. The same builders also shipped at the same time some side-tank engines having six coupled wheels, 39¾ ins. diameter, with leading and trailing pony trucks. They have cylinders 14×20 ins., and weigh 42 tons, of which 30½ tons are on the driving wheels. They work on lines having grades of 3%. These engines may be compared with others of the same type, designed and built in New Zealand (Eng. News, Nov. 14, 1891). Some of the older engines had balloon stacks, but the newer ones have extension smokeboxes and straight stacks.

South and Central America.

Argentine Republic.—Mogul engines with six-wheel tenders of the English pattern have been built for the Santa Fe Ry. (5 ft. 6 ins. gage).

Brazil.—Great numbers of engines have been built for this country since 1885, when the great 72-ton decapods for lines of 5 ft. 3 ins. gage were sent to the Central Ry. (then the Dom Pedro Segundo Ry.). Ten-wheel and consolidation engines of broad and meter gage, and both simple and compound, have been built for this and various other railways, while 84-ton twelve-wheelers have been built for the Central Ry. (Eng. News, Sept. 20, 1896). Tank engines, and special engines of 2 ft. gage, as well as numerous plantation engines,

TABLE OF DIMENSIONS OF AMERICAN LOCOMOTIVES FOR FOREIGN RAILWAYS.

Country	Fig. 1. Spain.	Fig. 2. Norway.	Fig. 3. Finland.	Fig. 4. Russia.	Fig. 5. China.	Fig. 6. China.	Fig. 7. Japan.	Fig. 8. Japan.	Fig. 9. Iga.	Fig. 10. Egypt.	Fig. 11. Cape Colony.	Fig. 12. So Africa.	Fig. 13. N. Zealand.	Fig. 14. Brazil.	Fig. 15. Brazil.	Fig. 16. Honduras.
Railway	Robla & Valmas.	State.	State.	Moscow, K. & Vor.	Lu Han.	Eastern.	Hankaku.	Kiushiu.		Soudan.	Governm't	Gold min'g	Governm't.	Paulista.	Sta. Maria Mag.	Honduras.
Gage	3 ft. 3⅜ ins.	3 ft. 6 ins.	5 ft.	5 ft.	4 ft. 8½ ins.	5 ft.	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.	5 ft. 3 ins.	3 ft. 3⅜ ins.	3 ft. 6 ins.
Builders	Baldwin.	Baldwin.	Richmond.	Baldwin.	Rogers.	Baldwin.	Brooks.	Schnecdy.	Pittsburg.	Baldwin.	Baldwin.	Porter.	Baldwin.	Baldwin.	Brooks.	Dickson.
Type	Consolidtn.	Eight-whl.	Mogul.	Ten-wheel.	Mogul.	Consolidtn.	Eight-whl.	Consolidtn.	Mogul t'nk.	Eight-whl.	Atlantic.	6-c'p tank.	Ten-wheel.	Ten-wheel.	4-c'p tank.	Ten-wheel.
Simple or compound	Simple.	Simple.	Compound.	Compound.	Simple.	C'mpound	Simple.	Simple.	Simple.	Simple.	Simple.	Simple.	Simple.	Simple.	Simple.	Simple.
Driving wheels, diameter	3 ft. 6 ins.	4 ft. 7 ins.	49.21 ins.	6 ft. 0 ins.	5 ft. 0 ins.	4 ft. 2 ins.	5 ft. 0 ins.	4 ft. 0 ins.	4 ft. 4 ins.	5 ft. 0 ins.	4 ft. 8 ins.	3 ft. 6 ins.	4 ft. 1 in.	5 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.
Truck wheels, diameter	2 ft. 2 ins.	2 ft. 0 ins.	31.10 "	2 ft. 11½"	3 ft. 0 "	3 ft. 0 "	2 ft. 3½"	2 ft. 4 "	2 ft. 2 "	2 ft. 4 "	2 ft. 4 "	2 ft. 2 "	2 ft. 4 "	2 ft. 6½"	2 ft. 0 "	3 ft. 0 "
Tender wheels, diameter	2 ft. 2 ins.	2 ft. 0 "	37.00 "	2 ft. 8½"	3 ft. 0 "	3 ft. 0 "	2 ft. 6 "	2 ft. 0 "	2 ft. 0 "	2 ft. 0 "	2 ft. 9 "	2 ft. 0 "	2 ft. 0 "	2 ft. 9 "	2 ft. 0 "	3 ft. 0 "
Wheelbase, driving	12 " 4 "	12 " 3 "	12 ft. 6½ ins.	14 " 9 "	13 " 9 "	13 " 5 "	13 " 2 "	13 " 2 "	11 " 2 "	10 " 6 "	11 " 4 "	10 " 4 "	11 " 4 "	10 " 8 "	5 " 8 "	11 " 5 "
" engine	19 " 11 "	18 " 3 "	24 " 4 "	23 " 5 "	21 " 9 "	21 " 9 "	18 " 6 "	19 " 2 "	16 " 6 "	22 " 6 "	22 " 8 "	20 " 10 "	20 " 10 "	20 " 0 "	11 " 8 "	19 " 4 "
" tender*	19 " 11 "	18 " 3 "	24 " 4 "	23 " 5 "	21 " 9 "	21 " 9 "	18 " 6 "	19 " 2 "	16 " 6 "	22 " 6 "	22 " 8 "	20 " 10 "	20 " 10 "	20 " 0 "	11 " 8 "	19 " 4 "
Weight on drivers	76,071 lbs.	28,300 lbs.	49,000 lbs.	91,990 lbs.	105,000 lbs.	119,412 lbs	47,000 lbs.	84,000 lbs.	61,500 lbs.	50,000 lbs.	64,720 lbs	64,000 lbs.	59,000 lbs.	103,008 lbs.	36,000 lbs.	41,000 lbs.
" total, loaded	88,120 "	64,000 "	64,000 "	133,280 "	125,000 "	137,412 "	68,000 "	94,500 "	70,000 "	73,000 "	100,220 "	84,000 "	79,250 "	134,381 "	56,000 "	56,000 "
" tender, loaded	45,500 "	29,000 "	33,000 "	82,700 "	83,000 "	84,000 "	45,000 "	53,000 "	62,000 "	49,500 "	68,500 "	40,000 "				
Cylinders, number	Two.	Two.	Two.	Four.	Two.	Four.	Two.	Two.	Two.	Two.	Two.	Two.	Two.	Two.	Two.	Two.
" diameter and stroke	17 x 22 ins.	12 x 20 ins.	15¾ & 25 x 20"	14 & 24 x 26"	19 x 24 ins.	14 & 24 x 20"	14 x 24 ins.	16 x 24 ins.	13 x 22 ins.	15 x 24 ins.	16 x 22 ins.	15 x 20 ins.	16 x 20 ins.	19 x 26 ins.	12 x 18 ins.	12 x 18 ins.
Boiler, diameter	4 ft. 8 ins.	3 ft. 3⅜ ins.	3 ft. 8⅝ ins.	5 ft.	5 ft.	5 ft. 6 ins.	4 ft.	4 ft. 8 ins.	3 ft. 10 ins.	4 ft.	4 ft. 10 ins.	4 ft.	4 ft. 4 ins.	5 ft. 2 ins.	3 ft. 4 ins.	3 ft. 4 ins.
" pressure	160 lbs.	160 lbs.	170 lbs.	180 lbs.	180 lbs.	180 lbs.	160 lbs.	180 lbs.	140 lbs.	160 lbs.	180 lbs.	160 lbs.	175 lbs.	200 lbs.	180 lbs.	180 lbs.
Firebox, length and width	84 x 27 ins.	45⅝ x 28 ins.	46¹⁵/₁₆ x 37¹⁵/₁₆ ins.	80⅝ x 36 ins.	84 x 41½ ins.	112 x 45 ins.	70 x 28½ ins.	84 x 29⅝ ins.	66 x 23⅝ ins.	70⅜ x 28⅝"	60 x 72 ins.	79 x 29 ins.	76⅝ x 39⅜"	89⅜ x 37¾"	60 x 24 ins.	58 x 27 ins.
Tubes, number	150	118	150	223	214	270	192	180	128	163	189	150	177	268	92	134
" diameter	2 ins.	1¾ ins.	1¹⁵/₁₆ ins.	2 ins.	2 ins.	2 ins.	1¾ ins.	2 ins.	2 ins.	2 ins.	2 ins.	2 ins.	2 ins.	2 ins.	2 ins.	1¾ ins.
" length	11 ft. 6 ins.	9 ft. 1in.	9 ft. 8¹⁵/₁₆ ins.	14 ft. 3 ins.	13 ft. 5 ins.	12 ft. 5 ins.	9 ft.	11 ft.	9 ft. 6⅝ ins.	10 ft. 8 ins.	14 ft. 11 ins	9 ft. 9¼ ins.	13 ft. 4 ins.	13 ft. 2¾ ins.	9ft. 10 ins.	9ft. 10 ins.
Heating surface, tubes	1,072 sq.ft.	457.77 sq.ft.	745.76 sq.ft.	1,750 sq.ft.	1,629 sq.ft.	1,780 sq.ft.	781 sq. ft.	1123.2 sq.ft.	834.17 sq.ft.	980.6 sq. ft.	1430.6 sq.ft.	....	1,320 sq.ft.	1867.80 sq.ft	493.0 sq.ft	603.84 sq.ft
" total	1,072 "	507.77 "	745.76 "	1,780 "	1,629 "	1,780 "	781 "	1224.2 "	889.37 "	988.0 "	1530.85 "	....	1,320 "	1967.80 "	493.0 "	687.70 "
Grate area	15.7 "	8.80 "	12.19 "	20 "	24.2 "	35.0 "	14 "	17.5 "	9.84 "	13.8 "	30.0 "	....	16.0 "	22.20 "	9.15 "	10.87 "
Water in tender or tank	2,000 galls.	1,000 galls.	1,500 galls.	3,700 galls.	4,800 gals.	4,000 gals.	2,400 gals.	3,000 gals.	1,000 gals.	2,400 gals.	3,000 gals.	1,000 gals.	2,000 gals.	2,640 gals.	2,640 gals.	1,600 gals.
Coal in tender or bunker	4 tons.	2 tons.	158.9 cu. ft.§	7 tons.	7½ tons.	7½ tons.	4½ tons.	5,600 lbs.	2,240 lbs.	4½ tons	4,050 lbs.	None	4½ tons	4 tons	2½ tons	2½ cords§
Type of tender	8-wheel	6-wheel†	4-wheel.	8-wheel.	6-wheel†	8-wheel.	6-wheel.	6-wheel†	None.	6-wheel†	8-wheel.	None	8-wheel.	8-wheel	8-wheel	None

*All Baldwin engines give total wheelbase of engine and tender.
†Rigid leading axle; 4-wheel trailing truck.
§Wood fuel.

have also been supplied. The four-wheel Abt rack-rail engines for the Leopoldena Ry. (meter gage) weigh 27 tons and take loads of 22 tons up a grade of 15%.

A good representative of large numbers of locomotives sent to Brazil within recent years, is the ten-wheel engine of the Paulista Ry. (5 ft. 3 ins.), shown in Fig. 14. It has an extended wagon-top boiler, with extension smokebox, and the guides are set close together, carrying a special form of crosshead. The equipment includes spring buffers and the Westinghouse brake, and the tender is of the eight-wheel pattern. The engine is designed

FIG. 15.—TANK ENGINE; SANTA MARIA MAGDALENA RY. (BRAZIL).
Brooks Locomotive Works, Builders.

to haul train loads of 270 tons up 2% grades at a speed of 25 miles per hour. Similar engines of identical design, but fitted with the Vauclain four-cylinder compound system, have also been built. These have cylinders 14 × 26 ins. and 24 × 26 ins. All these engines were built by the Baldwin Locomotive Works.

Another engine for Brazil is shown in Fig. 15, being a suburban engine for the Santa Maria Magdalena Ry. (3 ft. 3⅜ ins.) It has a saddle tank, and is carried on four coupled wheels, with leading and trailing pony trucks. Single-bar guides are used, and the engine is fitted with the vacuum brake. It was built by the Brooks Locomotive Works, Dunkirk, N. Y.

Chile.—Consolidation freight engines (Eng. News, July 22, 1897) and six-coupled tank switching engines have been supplied to the Government railways (meter gage), by the Rogers Locomotive Works.

Peru.—Engines of 3 to 10 tons (with and without tenders) have been built for plantation lines of 3 ft. gage.

Bolivia.—Engines with four coupled wheels and leading and trailing pony trucks, weighing 26 tons, have been built for the Antofagasta Ry. (2 ft. 6 ins.)

Ecuador.—Forney engines, with four 37-in. coupled wheels under the boiler, have been built for the El Oro Ry. (3 ft. gage). They have cylinders 10 × 16 ins., and weigh 22 tons, with 14 tons on the driving wheels. Diamond smokestacks are used. These engines were built by the Pittsburg Locomotive Works.

Colombia.—The Cartagena & Magdalena Ry. has 18-ton moguls and 35-ton consolidation engines, and the Girardot Ry. has 30-ton moguls. The Cauca Ry. has 23-ton side-tank engines of special design, with six coupled wheels under the boiler, a pony truck under the cab and a four-wheel tender, an extension of the front end of the tender frame being carried by the pony truck. All the lines are of 3 ft. gage.

Costa Rica.—The Costa Rica Ry. (3 ft. 6 ins.) has 45-ton side-tank engines, with six driving wheels and a four-wheel trailing truck, the frames being outside the wheels, to admit a wide firebox.

Honduras.—In Fig. 16 is shown a light ten-wheel passenger engine for the Honduras Ry. (3 ft. 6 ins.), which line is now owned by an American company. In its general appearance and with its balloon stack it resembles some of the older ten-wheel engines of American railways, but the steel cab, circular headlight and other features mark it as a modern engine. It has a boiler of the extended wagon top pattern, and its sandbox is so placed as to give a straight lead of pipe to the forward driving wheels, which wheels have blind tires. The guides are of the Laird pattern, and all the rods are of I-section. The tender is of the ordinary eight-wheel pattern, and has a railing to hold the wood fuel when piled up. The engine was built by the Dickson Locomotive Works, of Scranton, Pa.

San Salvador.—Two-cylinder compound engines of the mogul type have been built by the Pittsburg Locomotive Works for the San Salvador & Santa Tecla Ry. (3 ft.). They are wood burners, with balloon stacks, and weigh 32 tons, of which 28 tons are on the drivers. The cylinders are 14 × 22 and 22 × 22 ins. The tender is of the eight-wheel pattern, with a hood to shelter the fireman.

Guatemala.—The Western Ry. (3 ft.) has 38½-ton ten-wheel engines (Eng. News, Dec. 23, 1897).

San Domingo.—Rack rail engines for the Central Dominican Ry. and mogul plantation engines have been built, all of 2 ft. 6 ins. gage.

Cuba.—Eight-wheel and ten-wheel engines of about 40 to 45 tons, as well as tank engines, have been built, including one for a Spanish military railway (Eng. News, Sept. 24, 1896). These are mostly of standard gage, but the plantation engines are mainly of about 2 ft. 6 ins. gage.

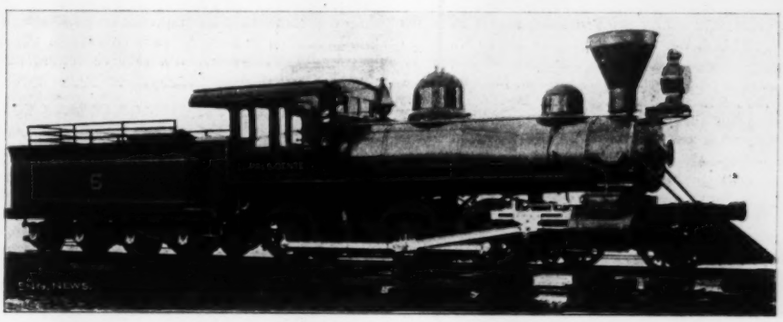


FIG. 16.—TEN-WHEEL ENGINE; HONDURAS RY.
Dickson Locomotive Works, Builders.

Jamaica.—Two-cylinder compound mogul engines, weighing 67 tons, have been built for the Jamaica Ry. (4 ft. 8½ ins.).

Mexico.

A large majority of the locomotives of Mexican railways are built in this country, including standard and meter gage engines of various ordinary types, and special engines for heavy grades and narrow gages. These latter include special consolidation engines for mountain service, and the Johnstone 115-ton, double-boiler, double-steam truck, eight cylinder compound engines for the Mexican Central Ry. (Eng. News, March 12 and 26, April 2 and 9, 1892). Mention may also be made of the 30-ton combined Abt-rack and adhesion engines for the Penyoles Mineral Ry. (2 ft. 6 ins. gage). This latter engine has six coupled wheels, and leading and trailing pony trucks. It will push a load of 14 tons up a grade of 13½%, with curves of 25°, at 4 miles per hour, and will control a 36-ton load in descending.

Canada.

Large numbers of passenger and freight engines, both simple and compound, have been built for all the important lines (4 ft. 8½ ins. gage), including two-cylinder compounds for the Canadian Pacific Ry., ten-wheel passenger engines for the Grand Trunk Ry. (Eng. News, July 28, 1898), and 92-ton consolidation engines for the Ottawa, Arnprior & Pacific Ry. For the Newfoundland Ry. (3 ft. 6 ins.), 40-ton ten-wheel engines have been supplied.

It will be noted that the foregoing notes include many engines of special design and with special features. Among these may be noted the rack-rail engines, steam-truck engines, compressed-air mine engines, oil burning engines, etc. In addition to the ordinary and special designs of locomotives for regular railway service, numbers of small engines for plantation, mining and industrial railways have been supplied to many of the countries above mentioned, and also to Nicaragua, Venezuela, Guiana, Uruguay, Porto Rico, Haiti, etc.

It will be understood, of course, that the above review makes no pretence to completeness. We have only attempted to mention a few of the more notable examples of locomotives built in the United States for foreign countries, and to give some idea of the great variety in the foreign orders which have been filled by American locomotive works.

THE NEW CHINESE RAILWAY FROM CANTON TO HANKOW.

The signing of a contract for a railway from Hankow to Canton, China, by the Chinese Minister at Washington, D. C., and the representative of the China Development Co., was briefly noted in our issue of Sept. 22, 1898. This contract or concession, as we noted at the time, covers a railway from Hankow, on the Yangtsze River, in the province of Hupeh, to Canton, in Kwangtung, and thence to the sea, with such branches as the Director General of Railways may approve. The American syndicate receiving the concession was headed by the late Senator Calvin S. Brice, and the surveys for the proposed line were placed in the hands of Mr. Wm. Barclay Parsons, M. Am. Soc. C. E., who sailed for China in October. Mr. Parsons arrived at Shanghai in November, and has just returned to America, where he will complete and submit his report to the China Development Co. Until this report is acted upon by the directors of the company, no details of the surveys will be made public, but the following general outline of the work has been furnished to a representative of Engineering News by Mr. Parsons.

Upon reaching Shanghai early in November, Mr. Parsons was met by one other member of the staff, who had preceded him, and was subsequently joined by two more. As soon as the necessary preliminary arrangements were effected, the party took a steamer up the Yangtsze River to Hankow. After a stay of a week at Hankow getting the outfit together, the party left to begin the surveys on Dec. 10, 1898. This party consisted of five engineers in addition to Mr. Parsons; Charles Denby, Jr., son of the late United States Minister, as interpreter and manager; a doctor, and Mr. W. W. Rich, formerly of Minneapolis, Consulting En-

gineer to the Imperial Director of Railways, nine white men in all. In addition there were two Chinese secretaries of the Director General, both of whom spoke English fluently, having been educated in the United States.

These persons constituted the survey party proper, but they were accompanied by various mandarins representing the Viceroy, the Governor of the provinces, the Director General, the local officials of the districts through which the party was passing at the time, and the officers commanding the guard. The size of this guard varied according to the likelihood of disturbance, sometimes being as great as 300 soldiers. The province of Hunan was where the greatest danger was feared. Nearly 450 miles of the survey were through this province, which is known as the most anti-foreign of any in China, but is also one of the richest provinces of the Empire. Foreigners are tolerated in the northwest corner, and a few, very few, have gone from north to south, but such journeys were confined to boats. The surveying party, on the contrary, had to go by land, and penetrate regions where no white man had ever been before. On account of the known hostility to foreigners on the part of the natives, much concern was felt by the high officials for the safety of the survey party, and extraordinary precautions were taken by every official to prevent trouble. Placards were posted along the route announcing the coming of the surveyors, and ordering the people to keep the peace. With few exceptions, however, the people were found to be most friendly and kindly disposed.

The line of survey beginning at Hankow followed the Yangtsze River for about 100 miles, and then swung inland toward the south to reach the Siang River, which is an important tributary of the Yangtsze. The valley of the Siang was followed to the Nanling Mts., which separate the Yangtsze valley from the watershed of the China Sea. Both the Yangtsze and Siang rivers resemble the Mississippi River in many of their physical characteristics. They are littoral streams, overflowing their banks and constantly changing their beds. Like portions of the Mississippi also, their banks are higher than the ground, lying inland, and are in many places further elevated by dykes to prevent overflow. The survey as made was carried along the banks, but an alternate route was found available along the foothills, about 15 miles inland. This latter route would be above the flood line.

Some difficulty was anticipated in finding a route through the Nanling Mts., but fortunately the labors of the engineers were rewarded by the discovery of a pass lower than the traveled highways, and hitherto unknown, with a good approach on both sides. The line through the mountains will be almost entirely canyon work, with a great deal of rock excavation and a number of small tunnels, generally through limestone. Once across the mountains the survey followed the drainage line of the Pei Ho or North River of China to Canton. Fairly easy construction will be had along this portion of the line.

The total length of the instrumental survey actually made was 742 miles, but the line could easily be shortened to about 710 miles in the location. The survey was carried out entirely by the stadia, and the average rate of progress was about 9½ miles per day. To indicate the accuracy of the stadia work, Mr. Parsons states that working from a known point to a known point the error in distance was ½ mile in 742 miles, or almost exactly 1 in 1,500. Besides the main line survey made with the stadia the party conducted nearly 200 miles of reconnoissance for branch lines, which was based on odometer measurements for distance and barometer and compass readings for elevation and direction. The surveys were made for a standard (4 ft. 8½ ins.) gage line, and they showed that very little bridge work would be required. As already stated, some of the country traversed was rough and mountainous, calling for heavy and expensive work, but much of it was highly cultivated and thickly populated. The engineers found extensive deposits of coal, both anthracite and bituminous; in fact, the area of the anthracite fields in Hunan alone is said to exceed that of the Pennsylvania fields. Other minerals are also known to exist, but have never been mined, owing to lack of transportation facilities.

In regard to the existing Chinese railways, and the prospects for American trade in China, Mr. Parsons gives the following statement:

The existing railways of China are the government line in the north, from Peking to Tientsin, and thence north towards Manchuria; a short line from Shanghai to Woosung, and the road from Hankow to Peking, now being constructed by a Belgian syndicate.

The development of American trade with China, and, indeed, with the whole of the East, is something remarkable, especially the great increases during the years 1897 and 1898. In certain lines of goods, such as cotton sheetings, for example, the American articles are already controlling the trade, and the forthcoming report of the Chinese Customs Bureau will make special note of this fact, and will state that the American mills can put on the market a better article at less price than Manchester can. American locomotives are used on both Japanese and Chinese railways, and with the construction of other lines in China, there will be opened a large market for American railway material. Light machines, hardware, and a variety of other articles could find an outlet in China if properly pushed. The Chinese would be glad to trade with Americans. On every hand I heard the greatest expressions of good-will and friendship and a desire for closer relations. Other nations, they say, have in view the seizing of territory, whereas our people desire merely trade, which would be of mutual benefit. The Tsung-li-Yamen at Peking, the governing body of the empire, gave me an audience on the completion of the survey, and expressed such views.

Since his return to America, Mr. Parsons has been overwhelmed by applications from engineers for positions, and he requests us to announce that no positions are open, and, therefore, that applications for work will not receive consideration.

THROUGH TRANSPORTATION ON COMMON ROADS AND STREET RAILWAYS.

A novel system of transportation which seems likely to become an important means of facilitating the traffic between cities and the outlying manufacturing and agricultural districts which are tributary to them, is a combination of road wagon and railway truck which enables the wagon to be rapidly hauled upon the tracks of a street railway instead of being hauled slowly along the road or street. In view of the extent to which street railways are now being built to cover long distances upon suburban and country roads, and in view of the much greater ease of traction upon such railways than upon a highway, it will be seen that a system which permits of the ready transfer of the wagon from the road to the railway will afford a greatly improved means of transportation. The system in question is the invention of Col. Joseph C. Bonner, of Toledo, O., and was first used in 1898 in that city.

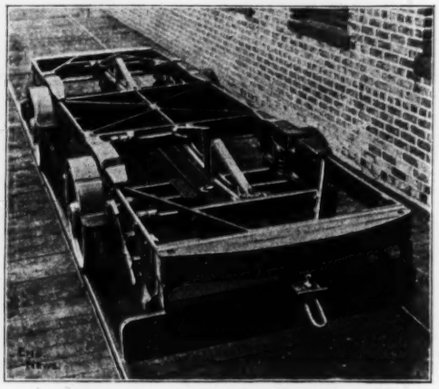


Fig. 1.—Car Truck for Carrying Rail-Wagons. The Bonner Rail-Wagon Co., Builders.

The wagon itself is of the ordinary pattern, but built for heavy loads, and fitted with extra strong running gear and springs. It is mounted on wide-tired road wheels. The carrying capacity is from three to seven tons, according to the character of freight to be handled. The car consists of a steel frame, strongly built and well braced, mounted on four street-car wheels with inside bearings. On each steel pedestal is a casting with a socket to receive the wagon axle, while movable grips, or dogs, on the center line of the car are arranged to wedge tightly against the axles and so hold the wagon firmly in position upon the car. The wagon wheels are then outside of the car wheels and some inches above the ground. Fig. 1 shows the car, and Fig. 2 shows a wagon and also a train of wagons mounted on their cars and attached to an electric motor car. At the transfer points either movable or permanent inclined planes and elevated rails for the wagon wheels are placed alongside the car tracks, so as to raise the wagon above the roadway sufficiently to allow of the truck being run under it and the axles secured by the grips. The wagon alone weighs, empty, about 3,000 lbs., and the car alone weighs about 4,000 lbs.

The cars and wagons are operated by the Bonner Rail Wagon Co. on the train-mileage system through leases or franchises granted by city and interurban electric railways, the company attending to the inspection and maintenance, the contracting for business, and the transfer to and from the railway tracks. The wagons are sent regularly (or as ordered) to stipulated points, beyond which they are hauled by the farmers' or manufacturers' teams. In the city the wagons are hauled to the warehouses, freight stations, etc., by the company's teams.

The company builds the wagons and trucks at its own factory, and made the first demonstration of its system at Toledo, with a daily service on two suburban lines—the Toledo, Bowling Green & Fremont Ry. (15 miles), and the Toledo & Maumee Valley Ry. (11 miles). The company had a central station, with tracks connecting with the lines of the Toledo Traction Co., and here the wagons were transferred to and from the trucks. In August, 1898, the city council passed an ordinance authorizing the company to make agreements with the street railway companies, it being provided that the rail-wagons should not interfere with the operation of passenger cars, should be operated by the same power as the street cars, and should not carry more than seven tons per wagon. The company also did a general express and freight business with its equipment. For instance, every morning a rail wagon collected the laundry work at the hotels in Bowling

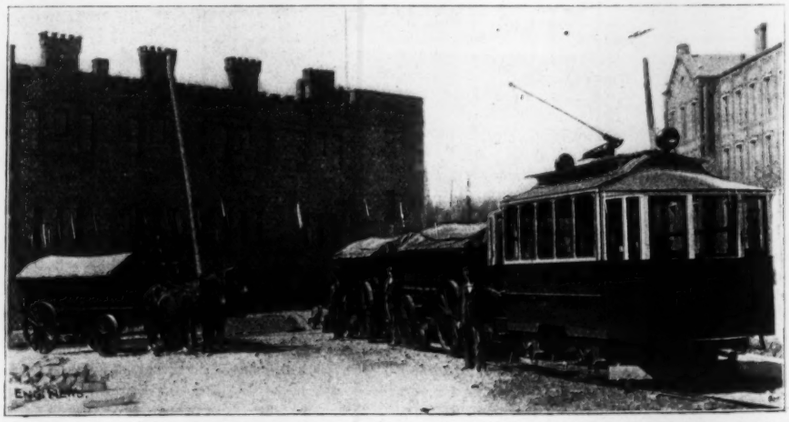


FIG. 2.—ELECTRIC MOTOR-CAR AND TRAIN OF RAIL-WAGONS ON TRUCKS, AT TOLEDO, O.

Green, and was then driven to the railway and placed upon its truck. At Toledo the wagon was removed from its truck at the central station and driven to the steam laundry. By this quick transportation the work was done during the morning and sent back on another wagon in the afternoon. The rail-wagon trains were hauled by a special motor car having two 25-HP. Westinghouse motors.

One day during the winter, when the roads were muddy, the incoming train included one load of 87 sacks of clover seed and two wagon loads of bass-wood lumber (3,000 ft. each). The farmers sending this shipment lived 15 miles from Toledo, and stated that with the roads in such condition the seed would have made at least three ordinary wagon loads and the lumber six ordinary wagon loads. This would have been equivalent to 270 miles travel of one driver and two horses. With the rail-wagon service the haulage was accomplished in one hour at a cost of about $6 per wagon from the shipping point to the delivery point.

The Toledo & Maumee Valley Ry. and Toledo, Bowling Green & Fremont Ry. have about 30 miles of line, upon which and the Toledo Traction Co.'s lines the service was in operation for about two months. The managers of these lines state that the service was successful but that there was not enough business to warrant its continuance, it being better adapted for lines radiating from larger cities than Toledo. Col. Bonner informs us that the service was discontinued because the mileage charge was excessive, being six times that now arranged at Detroit and the ruling prices there for rentals. During the entire period of operation at Toledo there was no accident to the service nor was a single daily train missed. He further states that many letters have been received from freight patrons and from one of the electric roads interested, asking his company to again place the rail wagons in commission in that city, which it will gladly arrange to do when mileage rates can be readjusted.

Since Jan. 1, 1899, the company has been operating a trial service at Detroit, Mich., under an arrangement with the Detroit Citizens' Electric Ry. and the Detroit & Pontiac Ry. Three rail wagons are used, and there are two trains each way daily between Detroit and Pontiac (25 miles), entering Detroit by Woodward Ave. and running to a central station in the business center of the city. A passenger motor car takes one rail wagon as a trailer. At the terminal, the rail wagon is transferred to the street and another is mounted on the rail truck. The train is then ready for the return trip. One teamster is employed in each city delivering and reloading the two additional wagons. The company has not used permanent loading platforms as yet, but uses temporary or movable skids. These are in four sections, one man easily handling each, and when not in use for transferring wagons they are carried on the motor car. In this way wagons can be transferred at any point as desired.

The company will endeavor to interest the several interurban railways centering at Detroit and induce them to adopt its system, in which event it would establish a common terminal and arrange for an interchange of rail-wagon service. Unless the question of municipal ownership intervenes to prevent, it is expected this may be accomplished. With more rail wagons a greater diversity of freight patronage would be secured, trains having two or more rail-wagon trailers would be run, and the receipts would be correspondingly increased.

The record at Detroit, as at Toledo, is said to have been very satisfactory, representative jobbers and shippers having written many letters asking for an enlargement of the service to include all the lines. Notwithstanding unfavorable conditions of weather no accidents or delays have occurred. The trains run on schedule passenger time. Freight and packages have been carried at a saving to patrons of 45% over the usual freight classification and cartage charges, and the delivery has been even more prompt than the express companies could furnish. In four weeks 1796 individual cartages were saved to patrons of the service. The earnings are said to be sufficient under these circumstances to pay all mileage allowances, teaming and other charges, leaving a good balance to the credit of the rail wagons.

The company considers that its experience establishes the fact that electric railways offer great opportunities to handlers of short-rail freight. A special advantage is that the shipment never passes through intermediate hands, such as truc.men, warehousemen, etc., and all rebilling and receipting from one carrier to another is avoided.

For particulars and photographs of the rail-wagons, and details as to the operation of the traffic and business, we are indebted to Mr. Joseph C. Bonner, President of the Bonner Rail-Wagon Co., Toledo, O.

SCHENECTADY LOCOMOTIVES FOR THE MIDLAND RY., ENGLAND.

One of the mogul freight locomotives built by the Baldwin Locomotive Works for the Midland Railway, of England, was illustrated and described in our issue of May 4, and we have since received particulars of similar engines built for the same railway by the Schenectady Locomotive Works, of Schenectady, N. Y. These latter engines differ in many important respects from the former, and closely resemble English machines, while the Baldwin engines are not dissimilar to an American locomotive in their external features.

The Schenectady engines have tenders of the standard six-wheel English pattern, with plate frames, instead of the rather clumsy-looking eight-wheel tenders (with trucks set close together) of the Baldwin engines. These Schenectady engines have also a peculiar form of extended wagon-top boiler, the throat sheet of which commences at the smokebox, and is nearly half the length of the boiler barrel. On the wagon top are the dome and safety valve casing, both of English pattern, while the sandboxes are placed below the running board, in front and rear of the main drivers. An extension smokebox is used, with the railway company's standard cast-iron smokestack. The firebox, tubes and staybolts are of copper. The firebox has plain grates, without rocking bars, and the ashpan is of ordinary form, with a damper in front.

The cab is of steel, of the American pattern, but set rather low down, so that the tops of the driving-wheels project through its floor. Two-bar guides and rods of I-section are used. The driving axles have long plate springs below the axles, while the truck has coiled springs attached to horseshoe yokes over the inside boxes. The tender axles have outside bearings, with plate springs set over the boxes.

The engine has bar frames, but the tender has plate frames the full depth of the pedestals, the weight being reduced by cutting away the web between the pedestals. It may be noted, too, that while the Baldwin eight-wheel tenders have 36-in. wheels, the Schenectady six-wheel tenders have 50¾-in. wheels. The fittings include two English injectors, made by Gresham & Craven, steam sand-jets made by the same firm, two 2½-in. Consolidated safety valves, spring buffers, and the railway company's standard arrangement of steam and vacuum brake.

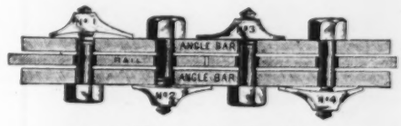
The dimensions of these engines are given below, in a standard form:

Schenectady Mogul Locomotives for the Midland Railway (England).

Running Gear:	
Driving wheels (6) diameter	5 ft.
Truck wheels, (2), diameter	3 "
Tender wheels (6), diameter	4 ft. 2¾ ins.
Driving wheel centers	Cast steel.
Truck wheels	Cast steel, with spokes.
Driving-wheels tires secured	By lip and ⅞-in. screws between all spokes.
Journals, driving axles	7½ × 8 ins.
Wheelbase: Driving	15 ft. 6 "
Total engine	23 " 0 "
Tender	12 " 3 "
Engine and tender	43 " 0 "
Wheels haying blind tires	None.
Weight in Working Order:	
On driving wheels	89,000 lbs.
Engine, total	107,000 "
Tender, empty	43,800 "
Cylinders: Diameter and stroke	18 × 24 ins.
Crosshead	Alligator; Guides. Two-bar.
Side rods	Solid ends.
Valve Gear: Type	Link.
Ports, steam	1½×16 ins.; ports, exhaust 3 × 16 ins.
Bridges, width	1¼ "
Slide valves style	Allen and American.
" " maximum travel	5 ins.
" " inside lap	None; outside lap 1 in.
" " lead (full gear)	1-16-in.
Boiler: (Worth basic steel)	Extended wagon-top.
Diameter, barrel outside first ring	4 ft. 6⅛ ins.
Thickness, barrel plates	⅝, 9-16, ½ and ¾-in.
Horizontal seams	Sextuple riveted, with ins. and outs. welt strips.
Circumferential seams	Double riveted.
Lap or butt joints	Butt.
Injectors (2)	Gresham & Craven.
Working steam pressure	190 lbs.
Firebox: (Copper)	Crown-bar.
Length, inside	6 ft.; width, inside 2 ft. 7¾ ins.
Depth	6 " 2½ "
Thickness, side and back plates	½-in.
Thickness, crown plate, ½-in.; tube plate	½ and ¾-in.
Crown stays	Crown bars, ¾×5 ins.; welded, each end.
Fire-brick arch	Supported on studs.
Stay bolts (copper) 11 threads; diameter	1-in.
Water spaces, width at front	4 ins.
Water spaces, width at back and sides	3 ins.
Grate	Dead bars.
Tubes: (Copper) No.	244
Diameter, outside	1⅝ ins.
Length over tube plates	11 ft.
Heating Surface and Grate Area:	
Heating surface, tubes (interior area)	1,128.87 sq. ft.
" " firebox	126.46 "
" " total	1,255.33 "
Grate area	15.87 "
Miscellaneous:	
Exhaust nozzle, single, high; diameter	4¼, 4½, 4¾ ins.
Smokestack, diam. at top 16 ins.; at base	14 "
Smokestack, height of top above rail	12 ft. 9½ ins.
Capacity of tender tank	3,800 U. S. galls.
Capacity of coal space	13,440 lbs.
Brake fittings	Combined steam and vacuum (railway company's standard.)

A NEW LOCK-NUT FOR RAIL JOINTS.

A lock-nut which combines the nut and spring lock in one piece is now being introduced for railway track work, and is reported as giving very satisfactory results under severe conditions. The nut is practically a heavy curved strap spring, with the threaded hole at about one-third the length of the strap, as shown in the accompanying cut. The bolt instead of the nut is turned in fitting up a rail joint. By the action of screwing it up, the nut is drawn flat against the splice bar, and the grip of the spring thus set up prevents any slackening of the bolt. In the event of any slight looseness occurring, the spring exerts a side pressure on the bolt, thus gripping it very firmly. In addition to this action upon the bolt, it is claimed that the grip is so powerful as to exert an influence in holding all the parts of the joint



Spring Lock-Nut for Rail Joints.
Automatic Rail-Joint Spring Co., Manufacturers.

together. The nut is made of spring steel, and is warranted to retain its spring. For frogs and crossings, nuts of extra strength are used, but in all cases keeping within the limits of the tensile strength of the bolts. It is claimed that four nuts are sufficient for any joint, and they may be put on the same side or on opposite sides of the rail, being staggered in the latter case.

At Grand Crossing, Chicago, four bolts and four lock-nuts were applied last September to joints that had formerly been secured by six bolts with two nuts and a spring washer to each bolt. It is said that the latter arrangement required tightening every few days, and that bolts were frequently broken, while the new arrangement was untouched until June, the bolts being tight and not one being broken. At the crossing of the Wisconsin Central Ry. and Pittsburg, Fort Wayne & Chicago Ry., at 16th St., Chicago, equally satisfactory results have been obtained in permanence of the joints and in the consequent reduction of track work. Seven lock-nuts were applied in November last to a curve guard-rail on the Lake St. Elevated R. R., where, owing to the sharpness of the curve, as many as 6 to 18 bolts were broken every week. Not one of the bolts has had to be tightened, nor have any of the bolts or nuts been broken.

This device is being introduced by the Automatic Rail-Joint Spring Co., 928 Stock Exchange Building, Chicago. Mr. Ernest D. Owen is President, and Mr. J. J. Harrell, General Superintendent, of the Company.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Entered at the New York Post-Office as Second-Class Matter.
Published every Thursday
at St. Paul Building, 220 Broadway, New York, by
THE ENGINEERING NEWS PUBLISHING COMPANY

GEO. H. FROST, - - - - - - - - - PRESIDENT.
D. McN. STAUFFER, - - - - - - VICE-PRESIDENT.
CHARLES WHITING BAKER, SECRETARY AND MANAGING EDITOR.
F. P. BURT, - - - TREASURER AND BUSINESS MANAGER.

WM. KENT, E. E. R. TRATMAN, M. N. BAKER, CHAS. S. HILL, J. J. SWANN, } ASSOCIATE EDITORS.

A. B. GILBERT, - - - - - - - ASSISTANT MANAGER.

CHAS. W. REINHARDT, - - - - CHIEF DRAFTSMAN.

ALFRED E. KORNFELD, New York,
M. C. ROBBINS, Chicago,
S. B. READ, Boston,
C. F. WALKER, Cleveland,
} ADVERTISING REPRESENTATIVES.

PUBLICATION OFFICE, 220 BROADWAY, NEW YORK.
CHICAGO OFFICE, 1636 MONADNOCK BLOCK.
BOSTON OFFICE, 299 DEVONSHIRE ST.
CLEVELAND OFFICE, OSBORN BUILDING.
LONDON OFFICE, EFFINGHAM HOUSE, 1 ARUNDEL ST., STRAND.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 2 months, $1.00. To all other countries in the Postal Union: Regular Edition, One Year, $7.60 (31 shillings); Thin Paper Edition, One Year, $6.31 (26 shillings). SINGLE COPIES of any number in current year, 15 cents.

In ordering changes of mailing addresses, state BOTH old and new addresses; notice of change should reach us by Tuesday to be effective for the issue of the current week. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 329 means that subscription is paid to the 32d week (that is the issue of Aug. 10) of the year 1899; the change of these figures is the only receipt sent, unless by special request.

ADVERTISING RATES: 20 cents per line. Want notices, special rates, see page XIX. Rates for standing advertisements sent on request. Changes in standing advertisements must be received by Monday morning; new advertisements, Tuesday morning; transient advertisements by Wednesday morning.

The partition of China among the great European powers, through the medium of so-called "spheres of influence," is attracting no small degree of attention at the present time. In England, Lord Charles Beresford, and in this country, Hon. John Barrett, the late United States Minister to Siam, are each calling attention to the injury to trade interests which is likely to result from such a partition. American manufacturers and exporters have built up a large trade in Manchuria and in northern Chinese cities, which is regarded as likely to be seriously curtailed now that these sections have come under Russian and German domination. It is urged by Mr. Barrett and by Lord Charles that a joint agreement between England, the United States and Japan, to insist upon the adoption of "the open door" principle in all parts of China could not be resisted by the other European powers, and would preserve the trade interests of these three nations in China, which are now threatened with serious curtailment.

There is little doubt that the prospects of loss of trade in China have not been at all overstated; but we are unable to see any prospect of any such action as Minister Barrett advises. The fact is, it is now too late to insist upon maintaining the integrity of the Chinese empire. The work of partition has proceeded too far. Two years ago, or even a year ago, had the United States been ready to participate, such a joint protest as is proposed might have been arranged, and might have been effectual. England, however, has now assented to the division, has secured her own field in the Yangtse valley, and can no more recede from her position than Russia and Germany and France can recede from theirs.

The only thing we can do, is to urge upon the respective foreign governments the adoption of the "open door" principle in their respective possessions, that the goods of all nations shall be admitted on equal terms. It is to be feared, however, that such an appeal will fall on deaf ears. We have taught the world protection too well and too thoroughly, to have the lesson unlearned. Russia and Germany and France are not in China for their health, or for any other purpose than to secure markets for their products. Free trade may suit the United States, now that it can underbid the nations of the world; but it is not likely to be adopted by Continental nations for their Chinese possessions, no matter what argument we may bring.

THE NEW TRANS-ISTHMIAN CANAL COMMISSION.

The President, after a delay of over three months, has finally appointed the members of the commission which is to "make full and complete investigation of any and all practical routes for a canal across the Isthmus of Panama to determine the most feasible and practical route across said Isthmus for a canal, together with the cost of constructing same and placing it under the control, management and ownership of the United States."

The new commission consists of nine persons, as follows: The three members of the commission appointed in 1897; Admiral John G. Walker, Gen. Peter C. Hains and Prof. L. M. Haupt, and six new members, Mr. Alfred Noble, Mr. Geo. S. Morison, Prof. Wm. H. Burr, Gen. Oswald H. Ernst, Ex-Senator Samuel Pasco, of Florida, and Prof. Emory R. Johnson.

Concerning the impropriety of reappointing Messrs. Walker and Haupt as members of this new commission, we expressed our frank opinion in our issue of March 23, when we showed in detail the partisan attitude which Prof. Haupt had displayed from the outset of his connection with the old commission, and the evidence that Admiral Walker was likewise unfitted to render a competent and impartial opinion upon the difficult questions at issue. We have seen no reason to modify in any way the statements which we then made public. On the contrary, the recent published utterances of Prof. Haupt since his appointment to the new commission, which we have reproduced below, have added emphasis to the opinions which we then expressed.

At the same time it is true that Messrs Walker and Haupt form so small a minority in this new commission that they can hardly lead it far astray in its final conclusions.

The fact that the majority of the commission comprises five such able engineers as Messrs. Noble, Burr, Morison, Hains and Ernst, is one on which the engineering profession and the nation is to be heartily congratulated. The appointment of Alfred Noble is especially worthy of commendation. There is probably no American engineer better fitted by talent, experience and reputation to undertake the responsibilities which will be placed upon this commission than Mr. Noble, and engineers throughout the country will recognize his appointment as one conspicuously appropriate. As expressed in a private letter received by us some time ago, from a well-known engineer, soon after it was first reported that Mr. Noble was to be a member of the new commission: "Nobody can sway, and no conditions can warp, the judgment of Alfred Noble."

We could have wished—and in this we believe the engineering profession throughout the country will second us—that other hydraulic engineers of eminence had been selected for the other engineering positions upon the commission. We believe that such a course would have given the appointments to those whose abilities made them the most deserving, and whose judgment could most safely be relied upon. We are by no means disposed to be hypercritical, however; and although Messrs. Burr and Morison have made their reputations through their achievements as structural engineers, and have had little experience, so far as we are aware, in hydraulic works, they are both engineers of eminence and broad ability, accustomed to handle large engineering problems, and they will doubtless render able service upon the commission.

Generals Ernst and Hains (giving each the rank which they have earned by recent service in the volunteer army), are each of them officers of high rank in the Corps of Engineers, and honored members of the American Society of Civil Engineers as well. Gen. Hains' experience already gained in his work on the Nicaragua problem, will make him, of course, a very valuable member, while Gen. Ernst has had a variety of experience in his nearly 35 years of service since the close of the war, including work on the Missouri and Mississippi River Commissions, and can be relied upon to do credit to his profession in the position to which he has now been appointed.

Ex-Senator Pasco has doubtless been selected to deal with the legal and diplomatic aspects of the canal problem. We find that when the Morgan bill was pending in the last Senate he made one speech upon it in which he showed a fair grasp of the questions at issue, opposed the purchase from the Maritime Canal Co. of the Cardenas-Menocal concession under the terms proposed in the Morgan bill, and favored direct construction of the canal by the War Department after proper concessions and privileges had been secured from Nicaragua and Costa Rica.

Prof. Emory R. Johnson, of the University of Pennsylvania, has been appointed on the commission, it is understood, to investigate the commercial and economic aspects of the canal problem, a matter which we have long urged should be made the subject of a thorough scientific inquiry, coincident with the prosecution of the surveys. We are exceedingly pleased that the President has recognized the desirability of more certain knowledge in this field. No part of the commission's report will be awaited with greater interest than that which tells what return the nation may fairly expect to receive upon its investment in "the big ditch." The statistics of ocean commerce are now so accurate and so easily procured, that it should be possible to estimate the future commerce of the canal with very fair accuracy.

What Prof. Johnson's qualifications may be for the work to which he has been assigned, we have not ascertained. A paper by him on the "Economic Aspects of the Nicaragua Canal" was published in the "Annals of the American Academy" in 1895, which was more notable for indiscriminate laudation than scientific accuracy. It contained, for example, a table which purported to give the saving in distance to be made by the Nicaragua route in voyages from New York and other Atlantic coast ports to ports in China and Japan; but the route with which the Nicaragua route was compared was that by the Cape of Good Hope, the Suez Canal route being entirely ignored! Nevertheless, one such bad slip should not condemn a man, and we sincerely trust that Prof. Johnson may appreciate the measure of his responsibilities, and undertake an unprejudiced and definite scientific investigation into the business side of the isthmian canal problem. What the people want is facts and reliable figures upon this matter. They have had quite enough of guessing and skyrockets.

It is worth while noting that the new commission will start on its work under much more favorable auspices than either of the two commissions which have preceded it. When the Ludlow Commission was appointed in April, 1895, it had no authority to do anything but study the route proposed by the Maritime Canal Co. of Nicaragua, and report as to the feasibility of this route and the accuracy and reliability of the company's estimates. The munificent sum of $20,000 was appropriated for this work, including the compensation of the members of the commission! As our readers are aware, this Board reported, in brief, that the company's surveys were incomplete, that its estimates were inadequate, and that its route and general plan of construction were probably by no means the best that could be secured. It advised that thorough surveys should be made before action was taken upon the canal enterprise, and presented estimates of the cost and necessary scope of such surveys.

This report was presented in October, 1895. Had its recommendations been at once acted upon, we have no doubt that the Nicaragua Canal would now be under construction. The Maritime Canal Co., however, at that time wielded a powerful influence at Washington. It had been for years trying to get Congress to guarantee its bonds, but had strenuously opposed the appointment of an

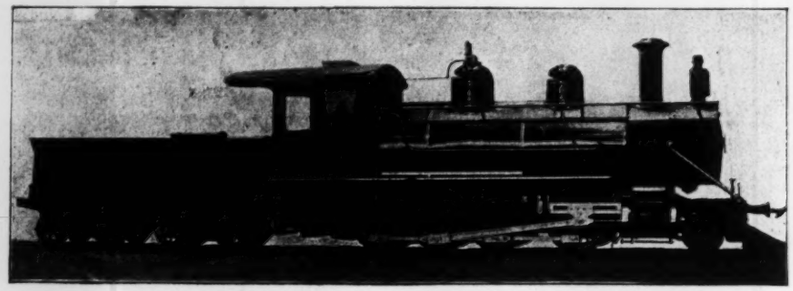


FIG. 1.—CONSOLIDATION ENGINE; LA ROBLA & VALMASEDA RY. (SPAIN)
Baldwin Locomotive Works, Builders.

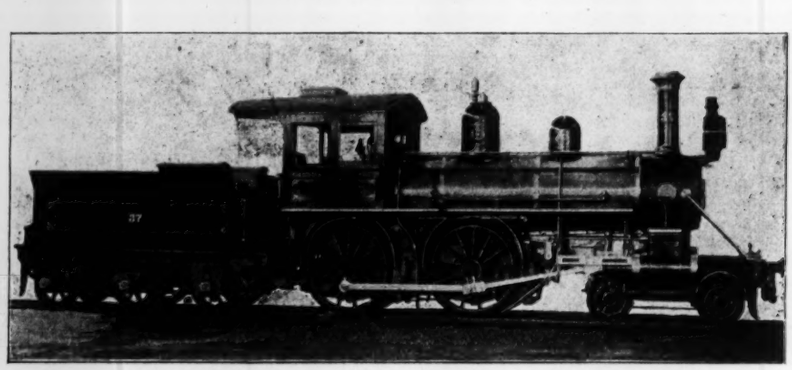


FIG. 2.—EIGHT-WHEEL ENGINE; NORWEGIAN STATE RYS.
Baldwin Locomotive Works, Builders.

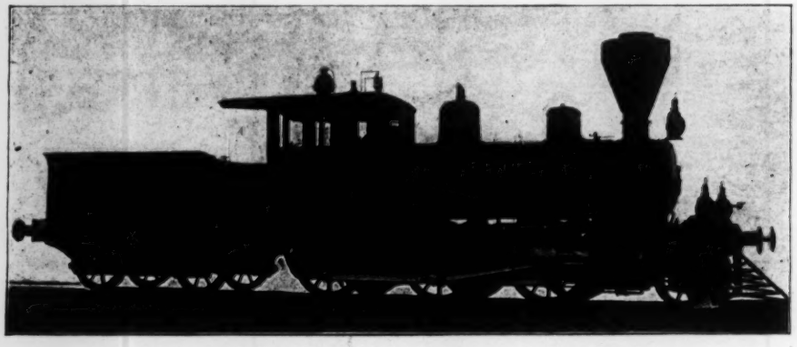


FIG. 3.—MOGUL COMPOUND ENGINE; FINLAND STATE RYS.
Richmond Locomotive Works, Builders.

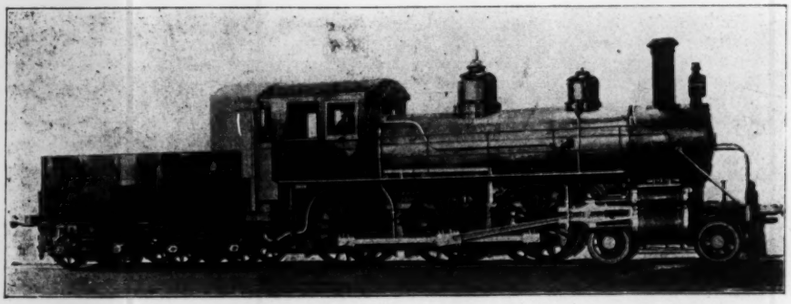


FIG. 4.—TEN-WHEEL COMPOUND ENGINE; MOSCOW, KIEFF & VORONESH RY. (RUSSIA).
Baldwin Locomotive Works, Builders.

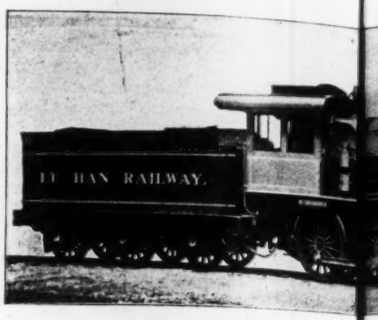


FIG. 5.—MOGUL ENGINE;
Rogers Locomotive

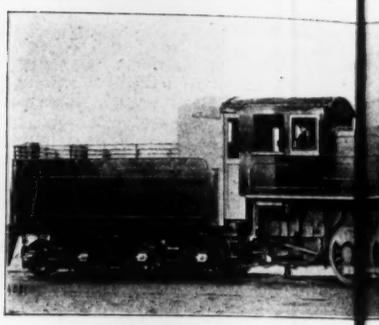


FIG. 6.—CONSOLIDATION COMPOUND E
Baldwin Locomotive Wo

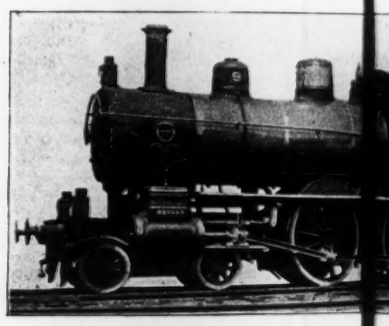


FIG. 7.—EIGHT-WHEEL ENGINE;
Brooks Locomotive Wo

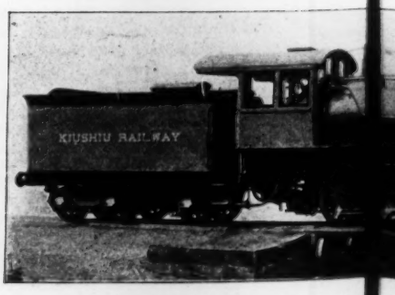
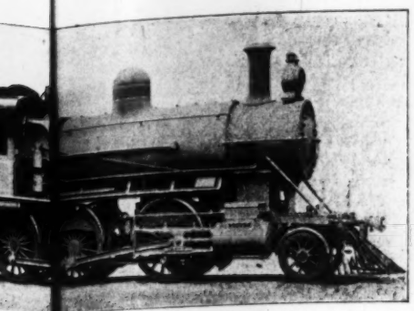
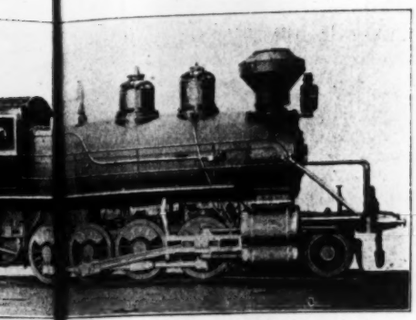


FIG. 8.—CONSOLIDATION ENGINE
Schenectady Locomotive

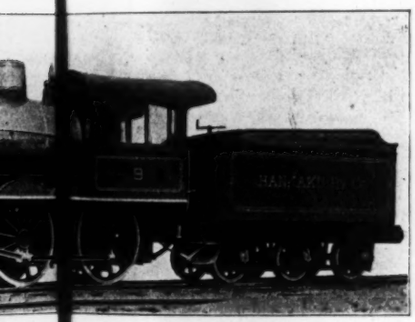
EXAMPLES OF AMERICAN LOCOMOTIVES



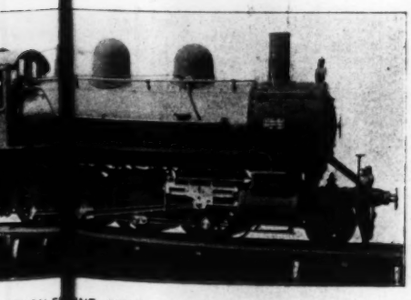
UL ENGI E; LU HAN RY. (CHINA).
Locomot e Works, Builders.



OMPOUN ENGINE; CHINESE EASTERN RY.
Locomoti Works, Builders.



EL ENGI ; HANKAKU RY. (JAPAN).
ocomotiv Works, Builders.



DATION E NE; KIUSHIU RY. (JAPAN).
tady Loco tive Works, Builders.

COMOTI ES BUILT FOR FOREIGN RAILWAYS.

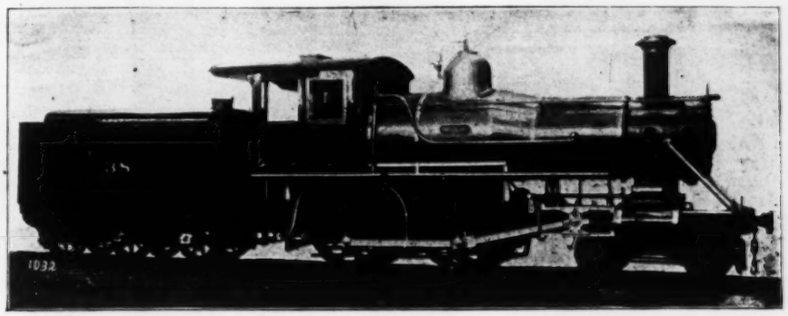


FIG. 10.—EIGHT-WHEEL ENGINE; SOUDAN RY. (AFRICA).
Baldwin Locomotive Works, Builders.

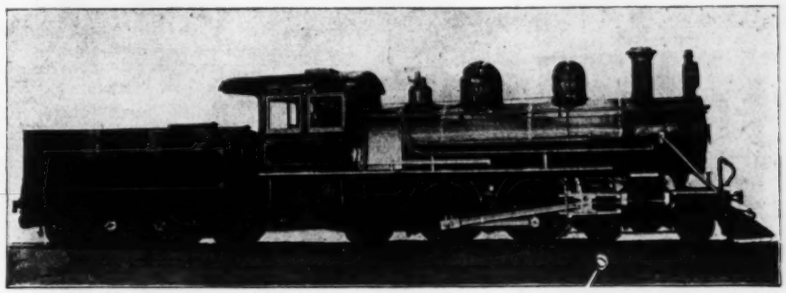


FIG. 11.—ATLANTIC ENGINE; CAPE GOVERNMENT RYS. CAPE COLONY).
Baldwin Locomotive Works, Builders.

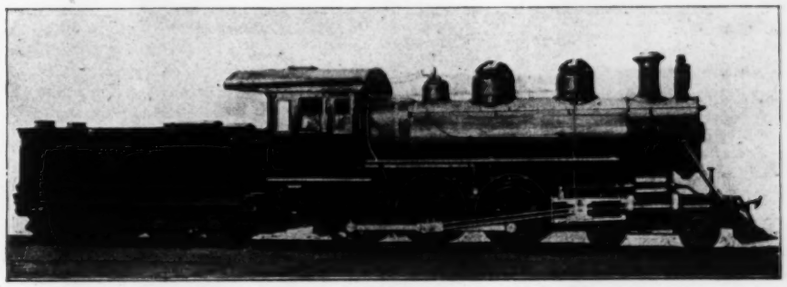


FIG. 13.—TEN-WHEEL ENGINE; NEW ZEALAND GOVERNMENT RYS.
Baldwin Locomotive Works, Builders.

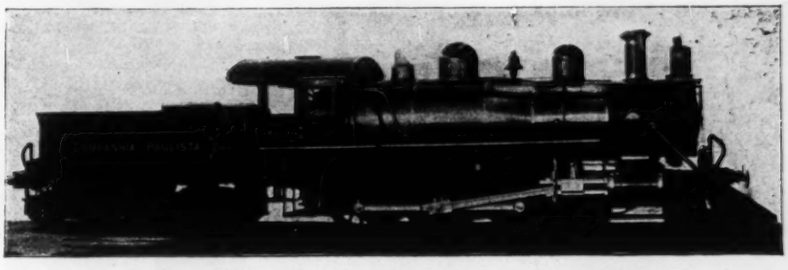


FIG. 14.—TEN-WHEEL ENGINE; PAULISTA RY. (BRAZIL).
Baldwin Locomotive Works, Builders.

engineering commission to examine its route and surveys. The Ludlow Commission was appointed, in spite of its opposition; but as soon as its report was rendered the company set to work to discredit it, by every means in its power. It opposed, tooth and nail, the proposal to send a new commission with equipment to make complete surveys, and used every endeavor to have the Ludlow report smothered and to get the coveted guarantee of its bonds by Congress. It was not strong enough, however, to secure its canal into the United States treasury, and it only succeeded in delaying for nearly two years the ordering of the complete surveys which the Ludlow Commission had advised.

In June, 1897, Congress appropriated $150,000 (less than half the sum recommended by the Ludlow Commission) for making new surveys in Nicaragua, and the Walker Commission was appointed. The question before it, however, was still that of the approval or disapproval of the old Maritime Canal Company's enterprise. Just how much influence that company exerted in the make-up of the commission, and of its staff, will probably never be known until the secrets of all hearts are revealed; but enough queer proceedings were made public to greatly injure public confidence in the work of the commission, and the reliability of its conclusions.

Whatever bias may have existed in favor of the Maritime company, however, the final report of this commission, submitted to the President two weeks ago, plainly confirms the report of the Ludlow Commission of 1895. Like that report, it advises radical changes from the Maritime Canal Company's route, and, in fact, dispenses with the most characteristic features of its location. Moreover, the final estimate of Gen. Hains, the army engineer member of the commission, varies only $1,346,000 from the provisional estimate made by the Ludlow Commission.

It did not need the report of the Walker Commission, however, to give the final quietus to the claims of the Maritime Canal Co. That corporation fought its last fight, we believe, at the last session of Congress. Before the next Congress assembles, its charter will have expired. Had the managers of that corporation been willing to turn over their enterprise to the Government five years ago for a reasonable sum, they could almost certainly have done so. They chose to play for high stakes or nothing, and they have got the latter.

We have deemed it important to give this brief outline of the recent history of the Nicaragua project; because it has been represented at various times by those interested in the Maritime Canal Co., that certain mythical "interests," the transcontinental railways, the Panama Canal promoters, "British syndicates," etc., etc., were conspiring to oppose and delay the Nicaragua Canal. Prof. Haupt, of the Canal Commission, has been especially active in circulating these statements, and even since his appointment as a member of the new commission, his name has appeared over the following characteristic interview:

Philadelphia, June 10.—Lewis M. Haupt, one of the members of the new Isthmian Canal Commission, in an interview to-day said:

"The appointment of this commission is simply another game of procrastination brought about by the allied opposition to the United States getting possession of a short route to the Far East. This opposition is powerful and active. It never rests, and when you come to analyze it, it is enough to make one despair.

"To begin with, there is the technical commission composed of English, French, German and other engineers, who made their headquarters here last year. Then there is the transcontinental railway opposition, who believe the canal would hurt their business. This is a mistake on their part, as deep waterways always increase the business of railways.

"Then there is the Panama Canal interest. The millions that have been squandered on that scheme, and the general impracticability of it, are matters of common knowledge. No Frenchman can be found to invest a penny in it. But the company which now controls it bought it for a song, and wiped out all the former obligations, and is working upon it to-day. The Government of Colombia got $100,000 a year out of it, and it is to their interest to keep the work going. But the great game is to saddle the Panama Canal on the United States—that is, to make this country pay for it, for France will always own the canal if it should ever be built."

Continuing, Mr. Haupt said that England's trade in the Far East being great, she is fearful of losing it should the Nicaragua Canal be opened. The Clayton-Bulwer treaty he said, is the greatest obstacle in the building of the Nicaragua Canal, and was drafted in the interests of English trade.

"Now, the Commission," said Mr. Haupt, "is composed of some of the ablest men in the country. In fact, you have threshed all of the wheat out of this thing already. They have been down there and spent two years and a lot of money. They have made an elaborate report, but who has ever seen it? If that report were published, as it ought to have been, the people would know by this time why the canal is not building. The commission will go down again, spend another two years, and the same old story will be told over again. The opposition is too powerful."

Apparently the Administration has at last awakened to the impropriety of such expressions on the part of one of its appointees holding a judicial and expert position, if the following press dispatch can be believed:

Washington, June 12.—The President has taken notice of the interview attributed to Professor Lewis Haupt, a member of the Isthmian Canal Commission, published in the newspapers last Saturday, to the effect that the whole project of the commission was only a scheme to delude people. Naturally the public expression of such a view, coming from a person connected with the commission, was received with great surprise, and Professor Haupt either has been or will be immediately called on for a statement. If he denies the authenticity of the interview, that will be regarded as sufficient. If he stands by the statements made in the interview, he must leave the commission, for, in the opinion of the Administration, his remaining would destroy its usefulness and make its report valueless. He has already received his commission, but this can be easily recalled should it be decided to make a change.

We do not see that Prof. Haupt's denial of this specific interview really affects the case, for he is on record in other public utterances similar in their purport to the above interview, as we showed in detail in our issue of March 23. It is certainly important, however, that no one holding such a position should be permitted to mislead the public further by such statements.

We venture to say, from a close study of the canal situation for many years, that neither the Panama Canal, nor the transcontinental railways, nor the "English syndicates" have interposed any real influence to delay the Nicaragua enterprise. The first two may possibly have gotten the ear of one or two members of Congress, but they can have done nothing more; and who is credulous enough to believe that any foreign syndicates could accomplish anything by lobbying at Washington?

These stories that this and that and the other interest was lobbying against the Nicaragua Canal, and hindering its construction, have been part of the stock in trade of the Maritime Canal Co., by which it has sought to stir up public sentiment in favor of its gigantic subsidy bill.

It is time that the public knew the truth, that the only influence which has delayed the construction of the Nicaragua Canal for the past half-dozen years has been the Maritime Canal Co. itself. Its bill for a Government guarantee of its bonds has been in every Congress since 1890. It opposed and delayed the proposal to have an unbiased commission examine its project, so that the Government might know what it was buying; and it insisted up to the very last that it would make no arrangement except one in which the Government would take the risks and the company would take the profits.

We gladly award credit—a great deal—to the company for its early work in exploiting its enterprise and bringing it to public attention; and for its general conduct of its affairs up to the time when its inability to finance its work became evident. Since that time its policy has been a most mistaken one, as its stockholders have now found out. We have not forgotten—and we trust the engineering profession has not—the attack which was made upon the personal and professional reputation of the members of the Ludlow Commission of 1895, when it was found that their report did not sustain the company's claims. The attempt to injure the reputation of Congressmen who opposed the company's subsidy bill, by representing that they were working in the interest of the transcontinental railways, or of certain mythical "syndicates," is a similar sort of work, and in so far as the company or its supporters are responsible for it, they deserve the condemnation of all right-thinking men.

As we have said above, the new commission starts on its work under favorable auspices. The public sentiment in favor of Government construction, and against subsidies to or alliances with any private corporation, has now been made so evident that there will probably be little attempt to influence the action of the commission. Enough preliminary work has been done on all the proposed routes to greatly facilitate the commission's work, and enable it to make a much broader study of the question than has been possible at any previous time. The public will await with interest its final conclusions.

WHY DOES THE UNITED STATES BUILD LOCOMOTIVES FOR FOREIGN RAILWAYS?

The export business of American locomotive builders has had a remarkable increase within the past few years, and is just now arousing considerable excitement in England, which has until recent years been the main source of supply for locomotives for almost all countries in the world outside of North America, Mexico and the larger European countries. The cause of this excitement is that the American locomotive builders have now pushed their competition to the very doors of their English rivals, and during the present year have booked orders for a large number of locomotives for English railway companies. This taken in connection with the growth in the export of American locomotives to other countries is interpreted as an indication that American locomotive shops are soon to take the place which the English shops have so long held as the chief source of supply of locomotives for the world.

There is a current idea, more or less widespread, that the export of American locomotives is something new. It will doubtless surprise many of our readers to learn that American locomotives were sent abroad three-score years ago.

In the very early days of railways, the United States builders won a signal victory over English builders of locomotives. In the location of the Birmingham & Gloucester Ry. (now a part of the Midland Ry. system), a grade of 2.7 per cent., and over two miles long, was introduced, which was known as the Lickey incline. It was proposed to work this by stationary winding engines and cables, but the engineer, after investigating English and American locomotives, ordered four engines from the works of William Norris, of Philadelphia, and they were used when the road was opened in 1840. This was the first English order for American locomotives. Each engine weighed 10½ net tons, and had a four-wheel leading truck and single pair of 4-ft. driving wheels, the cylinders being 10½ × 18 ins. These engines hauled loads of 33 tons at 12 to 15 miles per hour, and 53 tons at 8½ miles per hour. Mr. Bury, the noted English locomotive builder, sent one of his engines to compete with them, claiming that his engines could do anything that an American engine could do. The boast was not fulfilled, however, for the Bury engine could not ascend the grade even without a train. In consequence of the agitation over the use of foreign locomotives, Mr. McConnell, the Superintendent of Motive Power of the Birmingham & Gloucester Ry., designed a much larger engine in 1845 which successfully did the work, but the increase in train loads was not in proportion to the increase in size of the engine. It was a 30-ton tank engine, with six 45-in. driving wheels, and cylinders 18 × 26 ins.

It may be here noted that Mr. Norris also built locomotives for the French State Railways, and for railways in Austria, Germany, Italy and Russia. He also established locomotive works at Vienna and Paris. The Vienna works were financially unsuccessful on account of the strong opposition to foreign interests, and those at Paris were unsuccessful, owing to the political troubles of that time which practically killed all industrial enterprises.

Another Philadelphia locomotive builder, Matthias W. Baldwin, the founder of the great Baldwin Locomotive Works, also sent a locomotive abroad in 1841. He received the order in the previous year, the machine being for an Austrian railway, and the order coming through August Belmont, of New York. When he had nearly completed the engine, he learned that only 60 lbs. steam pressure was permissible, whereas his engine was designed for a steam pressure of over 100 lbs. He thereupon constructed another locomotive to meet this requirement, and shipped it the following year, and this engine was the first with a link-motion valve gear ever built at the Baldwin Works.

The rapid growth of American railways in the years following 1840, however, made such demands upon American locomotive builders that

foreign trade was neglected, and not until the '60's was it resumed. The war and the period of inflated prices which followed it seriously interfered with export trade, and not until 1875 or thereabouts did locomotive exports attain any considerable volume. In the fifteen years from 1875 to the beginning of 1890 there were 1,535 locomotives built in the United States for foreign countries, or an average of 102 per annum. The total value is estimated at about 14½ million dollars. The highest and lowest records were 282 engines in 1884 and 44 engines in 1876. Since 1889, about 2,410 engines have been built, representing a value of about $21,540,000, taking the average value (in years for which these figures are not obtainable) at $9,000 per engine. Thus within the past 24 years the United States has built about 3,940 locomotives for export, which represent a value of over $36,000,000.

The export business averaged quite small, in comparison with the home business, although in 1891 and 1894 it reached 12.7 and 11.5% of the total business. The high percentage in the latter year, however, was due mainly to the great drop in orders from home railways, the number of locomotives built at manufacturers' works in 1894 being only about one-third of the annual output for a few years previous. Since 1894, the engines built for foreign railways have represented nearly 30 per cent. of the total number built each year. The following table shows the course of American locomotive building during the present decade:

Year.	No. of locomotives built.*	No. built for export.	Per cent. for export.	Value.
1890.....	2,240	161	7.2	$1,280,600
1891.....	2,165	275	12.7	2,424,400
1892.....	2,012	197	9.7	1,717,700
1893.....	2,011	155	7.7	1,395,000
1894.....	695	80	11.5	720,000
1895.....	1,101	309	28.0	2,781,000
1896.....	1,175	279	23.7	2,625,000
1897.....	1,251	386	30.8	3,474,000
1898.....	1,895	568	30.3	5,112,000
Total....	14,525	2,410	16.6	$21,539,700

*Exclusive of those built in railway companies' shops.

Special returns which we have received from the locomotive building firms show that 8 out of 11 firms built no less than 568 locomotives for export during the year 1898. An examination of the records show that these were for over 30 different countries. As a matter of fact, there is now hardly any part of the world in which American locomotives are not to be found, and, as we have noted above, England is the latest addition to the list.

The reason for the growth of our locomotive exports during the past decade, and especially during the past year or two, is an evident one. It is that the United States is now the cheapest market in the world for the purchase of the raw materials from which a locomotive is made. Up to 1892 or thereabouts our export trade in locomotives was hampered by the fact that iron and steel cost more in this country than in Europe. The tables are now completely turned. England is buying steel plates and pig iron in the United States. The American producer has now the advantage which formerly was on the side of his competitor. Labor is more expensive in this country than abroad, it is true; but this is more than offset by its greater efficiency and in the greater employment of labor-saving tools in every part of the work.

Evidently, then, if American locomotive works can build equally as good machines as their rivals, there is no reason why they should not beat them in open competition. The record of the past three years shows that they are doing this. As for the quality of the machine which is produced, American cast iron is generally admitted to be superior to the European material; American steel is equal to that made anywhere, and American workmanship is conceded to be equal, and in many respects superior, to that found in the machine shops of any country in the world.

In the discussion concerning the recent success of American locomotive makers in securing orders from English railways, a great deal has been said concerning the merits and demerits of American locomotives, as if there was of necessity some difference in the design of a locomotive because it was built in an American works. Some of the English railway and engineering journals have even fallen into the curious error that American locomotive works built all their engines to a few standard types, and decline to vary therefrom. They have attempted to explain the recent successes of American locomotive builders on this basis, saying, in effect, that the Americans build locomotives as they build sewing machines, a dozen or a hundred exactly alike in every detail, and that consequently under this system of construction the cost of production and the speed with which work may be turned out, is far greater than in a works which builds to the purchaser's specifications and drawings.

We need hardly say to our readers that all this is as absurd as it is untrue. American locomotive works will book orders for English or French or German locomotives if the purchaser desires, as readily as for locomotives with distinctive American features. These works can make any detail of a locomotive that can be made in a foreign locomotive works; and if the purchaser prefers foreign details of any sort, they will be cheerfully furnished, provided his specification is accompanied with working drawings of what he requires.

On the other hand, American locomotive works are equally well prepared to fill specifications of the opposite class, which state only what service the completed machine is to be required to perform, and leave the design entirely to the builder. It may, perhaps, be imagined that in this case the company's "standard" machine comes into play, and a cut-and-dried machine of a certain standard size is turned out. This again is entirely wrong. Locomotives built to the company's specification are carefully designed to suit the work to be done, the fuel and water to be used, the climate to be met and the character of the attendants to which they are to be entrusted.

One great point that is almost always brought up in English discussions on American locomotives, is that they have steel fireboxes, which is generally represented as a defective feature. As a matter of fact, copper fireboxes, brass tubes, and any other specialties will be, and are, supplied by American builders to meet the requirements of their customers. We have taken the trouble to look up the descriptions of a number of engines built in this country for foreign railways, and as far as this question is concerned there is certainly no unanimous demand for the copper firebox. The result of this investigation is summarized below, showing the countries in which American-built locomotives have fireboxes of steel, copper, or of both materials:

Steel and Copper.—Norway, Finland, Russia, China, Japan, Western Australia, and Brazil. The engines for the Russian line across Manchuria have copper fireboxes; those for the other lines in China have steel fireboxes.
Steel.—Hawaii, Korea, Egypt, Soudan, New Zealand, Peru, Colombia, Guatemala, Mexico, Cuba, Jamaica, and Canada.
Copper.—England, Spain, Denmark, Cape Colony, New South Wales, and Victoria.

The impression still exists, abroad, that while American locomotives may be good enough for light and rough track, they are not suitable for good track—English track especially. This impression is based upon the old idea that all American track is light and rough, whereas many roads have track fully equal to that of the best English track, and much more rigid. If we take our deep and heavy rails with a 6 to 8-in. bearing on 16 to 18 ties to a rail length, it will be seen that they have much more bearing area than English rails with a 3-in. to 4-in. bearing on iron chairs with 10 to 12 ties to the same length of rail. The gradual introduction of the truck for locomotives by even the most conservative English railways and throughout Europe, shows that foreign engineers have largely discarded their old ideas as to this device being of advantage only on rough track with numerous and sharp curves.

In enumerating the advantages possessed by American locomotive builders over their European competitors mention should be made of the wonderfully efficient organization which has been developed in leading American locomotive works. In the largest of these especially, an enormous stock of working drawings, patterns and templates has been accumulated, and is covered by a system of records so perfect that any locomotive which the company has built, at least within the past thirty or forty years, can be duplicated upon order without the receipt of a single drawing or specification from the customer. Not only this, but any detail part of any locomotive can be furnished on short notice, made accurately to gage and ready to put in place. The great value of this system and of the accumulated drawings, patterns, etc., covering the work of many years, in enabling the works to fill all sorts of specification requirements at short notice and at minimum cost will be evident to any engineer.

In conclusion it may be well to point out that as yet only a small part of the locomotive export trade has come to us that may be expected in the future. From the following table it will be evident that England is still well in advance of us in this field, notwithstanding our recent orders from English railways:

Year.	Value of locomotives exported from Great Britain.	Year.	Value of locomotives exported from Great Britain.
1893.....	$4,113,300	1897.....	$5,030,680
1894.....	3,747,930	1898.....	7,413,795
1895.....	3,990,135		
1896.....	5,389,115	Total..	$29,684,955

At present locomotive builders the world over, like most other manufacturers, are filled with orders up to the limit of their capacity. This condition, however, cannot be expected to long continue. Sooner or later American and English firms will be found in sharp competition, and when this occurs the American firm, with its advantages of cheaper raw material, more efficient labor and machinery, and superior organization, may be relied upon to take the lead.

LETTERS TO THE EDITOR.

A Remedy for Iron Loss in Transformers.

Sir: In Engineering News for June 1, 1899, in connection with a report of the annual meeting of the National Electric Light Association, appears a comment on a paper by myself, entitled "Transformer Iron Loss—its Increase—the Remedy." In this you made one vital error in stating
that the system employed consisted in unwinding the coils of the transformers and after carefully annealing, etc., of the iron core, the coils were afterward rewound.

The method correctly outlined is about as follows: "The transformer to be treated is dismantled by removal of the iron laminations forming the core without disturbing the coils (which are usually machine-wound on forms). The iron is then treated under an "annealing process," which is done with great care as to proper and uniform temperatures on all portions of iron.

The transformer is then reassembled. The results of treatment under this system will insure reduction of core losses and the characteristics of iron will be returned to its original (or even better) condition than initially.

Yours truly, G. Wilbur Hubley.

Louisville, Ky., June 6, 1899.

(As far as the principle of the author's method is concerned, it is quite immaterial how the coils are removed. In applying the treatment to transformers in which machine-wound coils are used, the coils would, of course, be slipped off intact, as our correspondent suggests. Our abstract was intended to make clear the principle involved and its applicability to all types of transformers.—Ed.)

The Proposed Dam Across the Rio Grande River at Elephant Butte, N. M.

Sir: In the issue of Engineering News of May 25, I notice an item referring to the recent decision of the Supreme Court in the suit of the United States to enjoin the Rio Grande Dam & Irrigation Co. from building a dam across the Rio Grande at Elephant Butte, N. M., as another "set-back" to the company. This is an error. The effect of the decision is, in fact, the beginning of the end for a final triumph for the company, as all questions of law have been decided in favor of the latter, and one question of fact, only, left open by said court, viz.: "Does the company propose building such a dam as will substantially diminish the navigability of the Rio Grande, where now actually navigated."

This is a question of fact that will be promptly and finally determined in the courts of New Mexico, and one that the company in no wise fears.

If you will permit, I will say that the Rio Grande is regularly navigated near its mouth between the towns of Brownsville and Rio Grande city, some 700 or 800 miles below El Paso only—said navigation being unaffected by the condition of the river at and above El Paso, Tex.—the water for navigation being supplied by the Pecos, Concho and other tributaries—all below El Paso. The Rio Grande is to-day and for nearly a month has been entirely dry at El Paso, while the small amount of navigation near its mouth is going on regularly. In fact, the river has been officially reported to be rising down there during the last week.

The present conditions obtain every season to a greater or lesser degree. It is known generally to the inhabi-

tants of the Southwest that the whole contention relative to the navigability of the Rio Grande is a subterfuge to obstruct the operations of the above company.

The decision of the Supreme Court now brings the matter to a final issue, which will unquestionably result entirely favorable to the company, and is regarded by the latter as a final victory.

Counsel for the company advise that, under the decision of the court, construction on the dam may begin pending the inquiry mentioned. The local company is now awaiting advices from its London organization.

The enterprise has been crippled by the determined opposition of government officials high in authority, without whose influence the ridiculous contentions relative to the navigation of the river and fancied rights of citizens of Mexico to waters wholly within limited States territory could not have been so long maintained.

The construction of the proposed and now famous Elephant Butte dam will solve some interesting problems in water storage and irrigation.

Yours truly, J. L. Campbell,
Chief Engineer Rio Grande Dam & Irrigation Co.
Casas Grandes, Mex., June 3, 1899.

More Concerning "Kalor."

Sir: We note in your issue of June 1, 1899, on p. 347, an article on our compound "Kalor." We consider this article a very unjust attack on us. We are not swindlers and are not trying to defraud any one. We will take up your article in detail and answer your allegations to the best of our knowledge and belief.

First. We note that your attention was first called to the compound by Mr. W. H. Winslow, Secy. Superior Water, Light & Power Co., West Superior, Wis. Would say that we received an order from this concern and we forwarded to them 500 lbs. of Kalor with the distinct understanding that if the compound failed to make a saving they were not to pay for it. That certainly is a fair proposition, and in every case where we have received an order for Kalor we have sent it on approval, with the understanding that the goods were not to be paid for unless they were satisfactory. Under date of May 20, we wrote to the Superior Water, Light & Power Co. and asked them what results they were getting, and they replied stating that they had been unable to make a test owing to their feed water meter being out of order, and that they would advise us of the results as soon as they were able to make a proper test. Now, we are in business to make money, and we certainly would not ship our goods on approval unless we knew they had merit; moreover, the gentlemen connected with this company are not fools or knaves, and they did not go into this business with their eyes shut. We know that our compound will do what we claim, and we intend to put it on the market and push it for all it is worth.

Second. We note that Prof. Carpenter claims that he knows nothing about Kalor. This is true, as the compound that he tested was then called S. C. (394) Compound. We have adopted the word Kalor as our trademark, and the goods that we sell under this trade-mark are put under the same formula as the compound that Prof. Carpenter tested. We also note that Prof. Carpenter now claims that the compound has no merit whatever, and that he found by further test that a saving could be made by simply wetting the coal with water and expert firing. Prof. Carpenter is certainly entitled to his opinion; but we would refer you to an article in the issue of "Power" for June, 1899, on page 16. This article will show you for what purpose the test was made, and you will also note that it does not say anything about a further test having been made showing that the compound had no merit; we also enclose a copy of Prof. Carpenter's letter to "Power," dated May 20, 1892. You will also note that his letter ends with the statement that "I think from all these tests that we have established the fact that by using the compound on dry anthracite or on bituminous coals there is a decided advantage." Now in his letter to you dated May 26, 1899, we note he says: "It will be noted by referring to the letter that the trials quoted did show an apparent although slight advantage due to using the compound." You will notice the difference in these two statements, and we will leave to your judgment whether a saving of 9 to 16% is a slight saving or a decided advantage. The inventor of this compound, Mr. Harvey K. Flagler, is now connected with this company, and he tells us that the tests made by Prof. Carpenter were under his supervision and that he was present during the tests. The fact that Prof. Carpenter was not paid for the test is something that we know nothing about. There are several good reasons why the compound has not been put on the market before, but we do not think it is necessary for us to enumerate them. We can give you the addresses of quite a number of plants that are now using Kalor and are getting good results.

Third. We note you also investigated our testimonial which was signed by R. L. Outwait, chief engineer Metropolitan Electric Railway Co., Toronto, Canada, and that your letter addressed to that gentleman was returned to you by the post-office officials. Would say that this gentleman was connected with the Metropolitan Electric Railway Co., of Toronto, some years ago, and if you will please write to William Angus, Montreal, Canada, care Auld Mucilage Co., 17 Bluery St., we think he will be able to give you Mr. Outwait's address; also Mr. Angus can give you some information in regard to the compound, as it was on the market there some years ago under a different name, but the business was a failure owing to gross mismanagement. You will note that the circular letter referred to in your article was signed by the "National Fuel Compound Co.;" we have since changed our name to the "National Coal Saving Compound Co." The statement by "Power" in the article in their June issue that "Coalene" is the same as S. C. (394) Compound is not true, and we know nothing about Coalene.

We have written you at some length, and we trust you will give us fair treatment and publish this letter, giving it the same prominence in your paper that you did the article which has done us a great injustice.

Yours very truly,
National Coal Saving Compound Co.
E. E. Smith, Secy.
93 Broad St., Boston, Mass., June 9, 1899.

(As our readers are aware, Engineering News is always willing to afford an opportunity for the statement of both sides of any case, and we publish the above letter in full as received. At the same time, we cannot admit that our article was in any way unjust. The use of Prof. Carpenter's name in the printed sheet of testimonials was wholly unauthorized by him, as his letters to us show, and was likely to do serious injury to his professional reputation. Practically the only redress which an engineer has against such an injury is a public disclaimer in the technical journals, such as we published in our issue of June 1.

The following letter, received since the publication of the article on "Kalor," throws additional light on the subject:

Sir: I am very much obliged for the publication of my letter in your issue of June 1, 1899. I have just been looking at the original letter which I wrote the third person, to which I referred in my communication, and I find that the Fuel Compound Company has garbled that letter so that the case against them is still worse than I represented.

By referring to your issue of June 1 you will note that in my letter printed in the "Kalor" circular the last paragraph is as follows: "I think from all these tests that we have established the fact that by using the Compound on dry anthracites or on bituminous there is a decided advantage." The paragraph which I actually wrote was as follows: "Besides the trials reported here we have also made several others, and I think from all these trials we have established the fact that no benefit is to be obtained by using the Compound on wet anthracite coal, but on dry anthracites or on bituminous there is a decided advantage. As the investigation is still in progress I will not attempt to offer any explanation which may account for those results, but merely report to you the actual facts." This, you see, is quite different from the published letter. You understand the letter was a private one to Mr. F. R. Low, although I believe that he did print a portion of it. Our later investigations, which were soon concluded, showed that water was just as good as the Compound. Yery truly yours,

R. C. Carpenter.
Ithaca, N. Y., June 7, 1899.

Concerning the article in our contemporary, "Power," we find that it is substantially a warning to its readers to "go slow" in the patronage of coal treating compounds. The editor concludes by saying:

In the light of experience and of chemistry, we must confess that we regard all such compounds with suspicion, and would spend our own or a client's money upon them only after the most convincing proof of their advantage.

If the "National Coal Saving Compound Co." intends to do an honest business, and to make money, as it says, and really has a valuable compound for the treatment of fuel, it will do well to radically reform its business methods, cease the circulation of unauthorized and undated testimonials, and submit its product to the tests of some thoroughly equipped laboratory. A favorable and authentic report from such a source would carry some weight; but mere statements that one or a dozen or fifty concerns are using "Kalor" compound with satisfaction, and saving such and such amounts of fuel are far from convincing. The application of a new pair of trousers to the fireman has sometimes resulted in a fuel economy of 15 to 20%.

Until some such authentic testimony as that suggested above is put before us, we shall have to continue as skeptical as our contemporary above quoted.—Ed.)

Notes and Queries.

Our attention has been called by Mr. Kenneth Allen, M. Am. Soc. C. E., of Baltimore, to an error in the note on infiltration of ground water to the outlet sewer of Westboro, Mass., in our issue of June 1. The rate of filtration, obviously, should have been given as 489,000 gallons per day, instead of per hour.

TELEGRAPHING ACROSS THE ENGLISH CHANNEL.

The feat of attempting telegraphing across the English Channel, using the Marconi system of wireless telegraphy, mentioned in Engineering News for March 30, has been remarkably successful. Prof. J. A. Fleming, who participated in some of the tests, gave an interesting account of his experience with the system in a letter published in the London "Times," from which we quote as follows:

During the last few days I have been permitted to make a close examination of the apparatus and methods being employed by Signor Marconi in his remarkable telegraphic experiments between South Foreland, Eng., and Boulogne, France, and at the South Foreland lighthouse have been allowed by the inventor to make experiments and transmit messages from the station there established both to France and to the lightship on the Goodwin Sands. Throughout the period of my visit messages, signals, congratulations and jokes were freely exchanged between the operators sitting on either side of the channel, and automatically printed down in telegraphic code signals on the ordinary paper slip at the rate of 12 to 18 words a minute. Not once was there the slightest difficulty or delay in obtaining an instant reply to a signal sent. No familiarity with the subject removes the feeling of vague wonder with which one sees a telegraphic instrument merely connected with a length of 150 ft. of copper wire run up the side of a flagstaff begin to draw its message out of space and print down in dot and dash on the paper tape the intelligence ferried across 30 miles of water by the mysterious ether.

The general public are not much concerned with questions of priority, or with the claims or suggestions of rival experimentalists, but they are interested in ascertaining the serious possibilities of that which has been actually achieved. Signor Marconi has never hesitated to acknowledge that he has built upon the foundations laid by others, but a vast gulf separates laboratory experiments, however ingenious, from practical large scale demonstrations conducted with all that regularity and freedom from failure which is the absolute condition of their public utility.

I cannot help thinking that the time has arrived for a little more generous appreciation by his scientific contemporaries of the fact that Signor Marconi has by minute attention to detail, and by the important addition of the long vertical air wire, translated one method of space telegraphy out of the region of uncertain delicate laboratory experiments and placed it on the same footing as regards certainty of action and ease of manipulation, so far as present results show, as any of the other methods of electric communication employing a continuous wire between the two places. This is no small achievement. The apparatus, moreover, is ridiculously simple, and not costly. With the exception of the flagstaff and 150 ft. of vertical wire at each end, he can place on a small kitchen table the appliances, costing not more than $500 in all, for communicating across 30 or even 100 miles of channel. With the same simple means he has placed a lightship on the Goodwins in instant communication, day and night, with the South Foreland lighthouse. A touch on a key on board the lightship suffices to ring an electric bell in the room at South Foreland, 12 miles away, with ease and certainty. An attendant now sleeps near the instruments at South Foreland. If at any moment he is awakened by the bell rung from the lightship, he is able to ring up in return the Ramsgate lifeboat, and, if need be, direct it to the spot where its services are required, within a few seconds of the arrival of the call for help. In the presence of the enormous practical importance of this feat alone, and of the certainty with which communication can now be established between ship and shore without costly cable or wire, the scientific criticisms which have been launched by other inventors against Signor Morconi's methods have failed altogether in their appreciation of the practical significance of the results he has brought about.

THE DISCOVERY OF AN ASPHALT BED at Logansport, Ind., is reported. It is said to be controlled by Chas. B. Longwell and W. B. Place.

ANOTHER SECTION OF THE PALISADES was destroyed on May 30, by the explosion of 7,500 lbs. of dynamite in the rock known as Indian Head, now part of the quarries of the Carpenter Bros., about one mile north of Fort Lee. A heading was driven 75 ft. into the face of the cliff and then two other headings, each 25 ft. long, were driven at right angles to the first; in the latter the explosive was packed. The amount of rock dislodged is roughly estimated at about 100,000 cu. yds.

A NEW SYSTEM OF VALVES FOR STEAM ENGINES, AIR ENGINES AND COMPRESSORS.

By Fred. W. Gordon, M. Am. Soc. M. E.†

In steam or air motors there are four valves in each head, two for the inlet and two for the exhaust, each pair being an exact duplicate of the other. A valve really consists of a pair of valves, of the same diameter, connected by links to a rock arm, at an equal distance from the center of the rock shaft, one valve moving into the cylinder, the other away from it to open their ports. The valves are in equilibrium as to current and pressure. If we are referring to the head end of a cylinder, and the

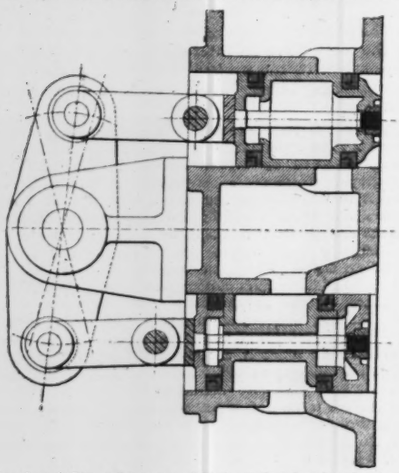


Fig. 1.—A New System of Valves for Steam Engines.

piston is at the dead point at that end, then the ends of these valves may be flush with the inside of the cylinder head, and the only clearance will be the circular beveling of the ends of the valves which move outward, and the ribbed chamber around the ends of the valves which move inward to open, together with whatever clearance is thought proper to avoid contact between the piston head and cylinder head. This total clearance need not exceed ½% for ordinary Corliss engine proportions as to diameter and stroke. The excess of the surface exposed to the steam upon its introduction to the cylinder is not more than 9% above the area of the piston head and cylinder head. A minimum of clearance, a minimum of surface to reduce internal condensation, and maximum of portage

When the engine is compound, the employment of the valves in the heads is conducive to direct and free passage between the cylinders, so that practically exhaust pressure in a high-pressure cylinder may be the initial pressure in a low-pressure cylinder. When the piston is at dead point, and the valves have the desired lead, and the ends of the valves nearly flush with the inside of the cylinder head, then, as the piston recedes from that end, one of the valves follows the piston and the other recedes from it. It will be seen, then, that no amount of increased travel of the valves materially increases the clearance, hence the system is especially adapted to shaft governing, where in shorter cut-offs the reduction of a small valve travel will affect the portage and cause wire-drawing.

For air compressors, which includes blowing engines used at blast furnaces, gas or any other elastic fluid compressor, the inlet valves are constructed so as to be similar to one pair of a steam engine's valves. The delivery or discharge valves may be similarly constructed, or modified as referred to further on.

Fig. 1 is a sectional elevation of a pair of these valves connected by link, and acting as one valve. The outer end of these valves at A are shown with metallic packing rings, to be used as marked when the valve is employed in compound compressors or where the inlet pressure exceeds the atmospheric. This system may be used in steam engines, but we prefer that shown on Fig. 2. This drawing is made to scale, and the clearance can be accurately calculated, the valves being 3 ins. in diameter and suitable for a 14-in. air compressor, and amply large for a 16-in. steam cylinder at 600 ft. piston speed. The actual portage of these valves is 13 sq. ins.

Fig. 2 is a side elevation of a steam cylinder provided with this valve system, and arranged for releasing gear, the left hand showing the steam valves and the right hand end the exhaust valves.

Fig. 3 is a blast-furnace blowing cylinder, 42 ins. in diameter and 30-in. stroke. Two of these set vertically are to be driven by gas engines, fed by the waste gases from the blast furnace. To effect economy with gas engines, high rotative speed is important, and, as these engines were coupled direct to the gas-engine shaft, they have to run at 160 revolutions per minute; hence the enormous size of the valves, to be made more than ample for 800 ft. piston speed per minute. Each of these valves is 11 ins. in diameter, two for inlet and two for outlet. Two separate eccentrics operate these valves through the intervention of rock arms and wrist plates. The diagram upon the drawing shows the position of each eccentric for taking air from the atmosphere and discharging it at 8 lbs. pressure. Each eccentric, being positively connected to the valves which it is to operate, leaves the matter of the extreme velocity of 160 revolutions per minute merely a question of large wearing surface and good workmanship. It is, however, apparent that the discharge in this

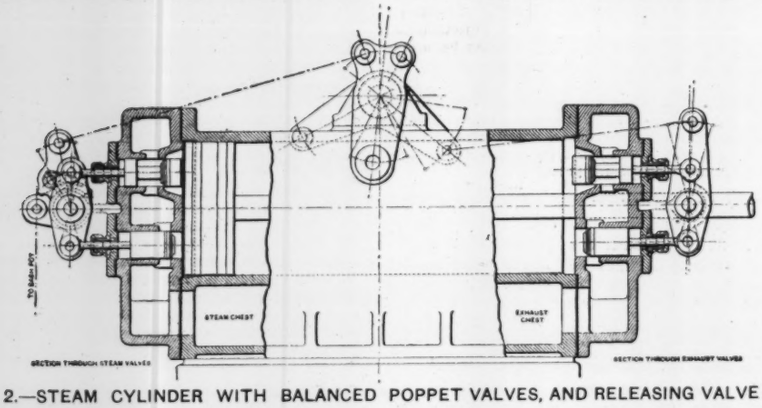


FIG. 2.—STEAM CYLINDER WITH BALANCED POPPET VALVES, AND RELEASING VALVE GEAR.

are the claims for this system. The illustrations show the adaptability of the system for shaft-governed or automatic liberating engines. The details of these need not be dwelt upon, as they would be modified for each particular case. Neither is it necessary to call special attention to the method of packing the piston valves, as that is not essentially a part of the system, though it is believed the double ring shown is the best—it certainly has proven to be tight.

These valves being placed in the heads of the cylinder, and the valve cylinder's bore being parallel with the bore of the main cylinder, the inner flush ends of the valves are parallel with the inside of head. The distance from the cylinder to the port is shorter than usual, reducing the resistance and change of temperature incident to long ports.

instance is fixed. When the pressure within the cylinder reaches 6 lbs. above atmospheric pressure, then the discharge valves are line and line to open. Referring to the action of the automatic discharge valve, it will be seen that this early opening is a decided advantage rather than an objection, and that being line and line at 6 lbs. pressure, the valves would compress air economically to 10 lbs.; in fact, more economically than if the valves were set to be at line and line when the air reached 10 lbs., or the discharge pressure intended.

The same valves are employed for vertical piston blowers, so named as they are expected to supplant the rotary blowers used up to, say, pressures of 4 lbs. per sq. in. They are simple piston blowers, as shown in Fig. 4, with but two valves in each head, one of these valves being used for the inlet and the other for the discharge, and all four valves driven by a single eccentric. The valves are always in balance as to pressure and weight of parts, so that the speed at which this machine can be operated simply depends upon the construction of it and the area of the valves. In this instance each valve is made 12 ins. in diameter for a piston 42 ins. in diameter, giving an area of 1-12, and they are intended for a piston speed of 600 ft. per minute. The valves may or may not be metallic packed, depending upon the pressure for which they are to be used. These engines may be set in series, so as to balance each other perfectly as to the weight of parts, and be driven at very high rotative speed. Those shown are intended for 200 to 250 revolutions per minute. They can be depended upon for tightness as completely as the best steam engines. The rotary blower is particularly faulty in this. It is difficult to measure the waste by leakage in rotary blowers; the best effort the writer has been able to make was in calculating the quantity of air by their displacement used to the consumption of a pound of coke in cupola practice, where he found as high as 112 cu. ft. required by them, whereas in blast-furnace practice, with modern blowing engines, 56 cu. ft. is found ample. Equating the two operations on a liberal basis shows that this particular blower was delivering but 60% of its volume, and this at a pressure of only 12 to 13 oz. The necessity for tight blowers, where a pressure of 3 to 4 lbs. is used, as in silver smelting and pneumatic transmission, is apparent. The design submitted is especially intended for this class of work.

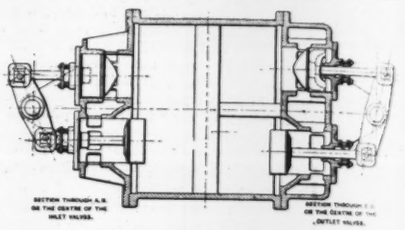


Fig. 3.—42 × 30-in. Air Cylinder of Blast Furnace Blowing Engine to Run at 160 Revolutions.

(Combined area of inlet and outlet ports 190 sq. ins. each, or one-seventh area of piston. Clearance, 0.5%.)

*Extract from a paper presented at the Washington meeting of the American Society of Mechanical Engineers.

†Chairman Philadelphia Engineering Works, Ltd., Philadelphia, Pa.

THE DIFFERENCE BETWEEN GOOD AND BAD INCANDESCENT LAMPS.*

By Francis W. Willcox.

There is no manufacturer of incandescent lamps, however inexperienced or limited in facilities, who does not claim to make a better lamp than any on the market. With every manufacturer claiming superiority for his product, the inquiring purchaser naturally becomes puzzled and needs must adopt some method of separating the good from the bad.

There are three things in general that distinguish high grade from low grade lamps: First, freedom from physical defects in the mechanical make-up of the lamp; second, correctness and uniformity in rating of specified candle-power and watt consumption at marked voltage; third, degree of maintenance of candle-power in service and the uniformity of performance in this respect.

Physical Defects.—The most prominent of these are loose caps or bases, bad connections in base, poor vacuum and spotted or discolored carbons. The last defects can be detected by examination of the lamp filaments by light, when they should reveal a clear, smooth, solid dark gray surface, and by burning the filament at a dull red, when it should show up thoroughly uniform and free from any bright or dark spots. No lamps containing more than 10% of such defects should be accepted.

Correct and Uniform Rating.—Good lamps should measure well within 6% above or below the rated wattage and within 10% above or below the rated candle-power at the marked voltage. Correct and uniform rating produces full and uniform brilliancy, and avoids the marked contrasts so detrimental to good lighting, effects which lamps of wide range in candle-power invariably give. It insures good average life by reason of the uniform initial efficiency of the lamps.

Candle-Power Maintenance.—The real purpose of a lamp is to give light, and as all lamps decline in candle-power after a number of hours' service, it is the relative amount of decline, other things being equal, which determines the best lamp.

Other features of incandescent lamps which, while desirable, affect the appearance of a lamp rather more than actual performance, are uniformity in size and shape of bulb and of the various parts of the lamp, as well as symmetry in form of filament and ability of filament to withstand drooping when burned in a horizontal or inclined position.

The Standard Oil Co. uses in the course of the year about 17,000 incandescent lamps, and tests are made to determine the make of lamp to be used. In the last series of tests the following method was pursued: First, the purchasing department bought in the open market.

*Abstract of a paper in the "Electrical World and Electrical Engineer."

unknown to the manufacturers, 12 different makes of lamps. This insured obtaining an average product, and avoided specially selected lamps; second, 50 lamps of each make were bought, thus insuring sufficient lamps of each make to give fair average results; third, the lamps were ordered all of one candle-power, efficiency and voltage—16 c. p., 3.5 watts and 116 volts. This insured equality of conditions for the lamps; fourth, the labels were scratched off and each lot of lamps was marked by numbers, the individual lamps of each lot being numbered from 1 to 50. They were then turned over to the civil engineer of the company, the purchasing department withholding the names corresponding to the lot numbers. This insured against any personal bias on the part of the testing engineer, and further provided for tabulating the results of each individual lamp; fifth, all lamps were tested in a rotating-stand photometer. This insured very accurate readings in candle-power, and

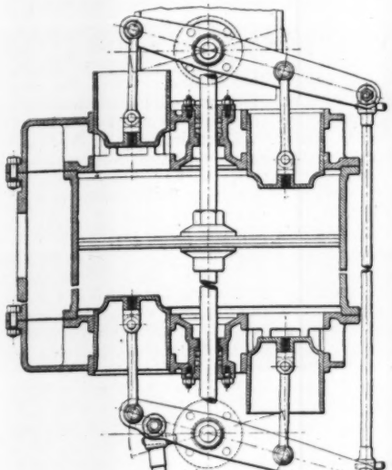


Fig. 4.—Air Compressor for High Speeds and Low Pressures.

gave the mean horizontal candle-power of each lamp at every reading; sixth, correct and reliable instruments were used.

Direct current was employed in all cases. The watts used were obtained by multiplying volt and ammeter readings, and a Bunsen portable photometer of the grease-spot type was employed to obtain the candle-power.

The actual tests were as follows: First, the lamps were all tested for initial candle-power and wattage readings at marked voltage. The readings of each lamp were noted opposite its number. The results obtained were noted and plotted so that what may be termed the distance from the true values could be seen at a glance. All lamps coming within a certain limit were reserved for further tests, the others being rejected. As a result of this only 8 makes remained for further test. Second, 10 lamps of each make were picked out of the 8 remaining lots, those being selected that were nearest to the candle-power and the efficiency ordered, i. e., 16 c. p., 3.5 watts per c. p. at 116 volts. In this selection preference was given to the watts, so that the different makes would burn as near as possible to the same efficiency, a necessary condition for correct comparative results.

The necessary number of sockets for life tests were so placed that the lamps burned in a horizontal position. Each socket was labeled to correspond with its lamp. After the test each lamp would go back into the same socket so that the filaments might be kept in the same horizontal position throughout the test, and the drooping tendency was thus determined. The voltage was kept constant and the candle-power and current readings were taken on each lamp at the end of 50, 105, 210, 310, 405, 500 and 600 hours steady burning.

From the data thus obtained curves of candle-power of each of the 10 lamps were plotted, and from these an average curve was prepared for each make of lamp. Watt curves were prepared in the same manner. A study of these data enabled the best make of lamp to be selected. As a result of the test it was definitely shown that the best lamp was worth 4 cts. more than the second best, and 5.82 cts. more than the third best. These figures were based on the assumption that current for lighting cost only 2½ cts. per kilowatt hour, which is a low figure.

THE ALLEN VALVE FOR LOCOMOTIVES.*

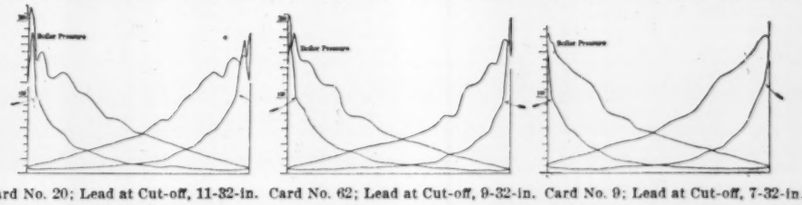
By C. H. Quereau, M. Am. Soc. M. E.†

There are decided differences of opinion among railroad mechanical men as to the value of the Allen, or double-ported, valve, a diagram of which is given in Fig. 1. Those who favor its use claim that it secures a greater mean effective pressure than the plain valve by giving a more prompt and full admission, thus increasing the power of locomotives on which it is used. Those who oppose its use claim there is no difficulty in getting all the steam into the cylinders that is needed without the Allen port, the main difficulty being to reduce back pressure and compression; that if the Allen valve gives a freer admission, its use necessarily increases the difficulty of getting the steam out of the cylinders, increasing back pressure and compression and causing the engines to pound badly.

Objections.

Strictly speaking, compression is the period of the stroke from exhaust closure to lead opening. The term "excessive compression" is commonly used to denote a suddenly rising pressure at the end of the return stroke which takes the form of a loop on the indicator card, and is usually wrongly assumed to be caused by the compression of steam remaining in the cylinder at the time of exhaust closure. If exhaust closure takes place at half stroke with 3 lbs. back pressure and 8% cylinder clearance, the pressure in the cylinder at the end of the stroke will reach only 113 lbs. If the back pressure is 12 lbs. and compression begins at 15 ins., the full stroke being 24 ins., the highest pressure attained at the end of the stroke will be but 137 lbs. With the usual locomotive valve gear and the valve line and line inside, compression begins at about 15 ins. of the return stroke. These facts remain true whether the valve is of the common type or an Allen valve. From the foregoing it is quite evident that the Allen valve cannot produce a compression equal to the boiler pressures commonly used, and we must look elsewhere for the cause of the so-called excessive compression complained of. That this cause is excessive lead, I believe will be clearly shown by the cards in Fig. 2, which were all taken from the same engine, having Allen valves, under practically the same conditions except a difference in lead and which clearly prove that the Allen valve can be so set as not to produce excessive compression. (The engine from which these cards were taken had drivers 68 ins. in diameter, valves with 5-in. travel in full gear, ⅞-in. outside lap, and Allen ports ⅛ × 17¼ ins., inside clearance 1-16-in. on each end, cylinders 19 × 24 ins., and steam pressure 165 lbs.

In view of the preceding, it seems to me clear that those who criticise the Allen valve have made the mistake of assuming that the excessive compression frequently found to accompany its use is due to so free an admission of steam from the beginning of the stroke up to the cut-off as to produce abnormal back pressure and compression, while the facts in the case are that the objectionable results are caused by too much lead, which can be easily remedied, without losing the advantage claimed for this valve. That the objectionable feature of undue compression can be obviated seems evident from card 9 of Fig. 2. Here the average back pressure from the beginning of the return stroke up to the point of exhaust closure is 7 lbs. Taking into consideration the fact that the drivers were making 267.6 revolutions per minute when the card was taken, and that these are representative cards among hundreds taken under similar conditions, it seems evident



Card No. 20; Lead at Cut-off, 11-32-in. Card No. 62; Lead at Cut-off, 9-32-in. Card No. 9; Lead at Cut-off, 7-32-in.

FIG. 2.—INDICATOR CARDS TAKEN FROM LOCOMOTIVE WITH ALLEN VALVE SET WITH THREE DIFFERENT LEADS, AND AT A SPEED OF 55 MILES PER HOUR.

that the Allen valve cannot justly be considered as producing more back pressure than the plain valve.

It is sometimes objected that the Allen port necessitates a weak design, or the valves must be made very heavy. For about ten years the Chicago, Burlington & Quincy R. R. has been using, very successfully, on 19 × 24-in. engines, having steam ports 1½ × 17¼ ins., Allen valves weighing only 112 lbs. without packing strips.

Advantages.

It is evident that the Allen valve doubles the speed of the steam port in opening and closing for all cut-offs, and in this respect more nearly approaches the advantages of the Corliss valve-gear than does the ordinary valve. That this is a decided advantage can hardly be successfully disputed. It is equally evident that for all cut-offs, where the maximum port opening does not exceed the width of the supplementary port, the Allen valve doubles the port opening. As the width of the Allen port is quite commonly ½-in., and a maximum port opening of this amount corresponds to a cut-off of 9 ins. with the usual locomotive gear, it follows that the Allen port doubles the steam opening for this and all shorter cut-offs, or for all those commonly used for speeds higher than ten or fifteen miles an hour. It therefore appears evident, on theoretical grounds, that the Allen valve increases the power of a locomotive for all speeds above very moderate ones, and that this advantage will be marked for high speeds.

That these theoretical advantages are borne out by practical results is shown by the statements of many railway motive power officials of high standing.

For engines which are already built it seems plain that

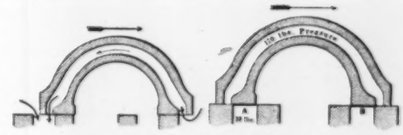


Fig. 1.—Diagram Illustrating Operation of Allen Double-Ported Slide-Valve.

the Allen valve furnishes a simple method of increasing their power, and in designing new engines will produce a given power with smaller and lighter valves, because of the shorter ports in the valve seat necessary with this valve, resulting in less strain and wear on the valve gear and seats. It may be urged that a plain valve with longer travel will give as great a mean effective pressure as the Allen valve, but this necessitates a heavier valve and consequent wear to the valve gear, and more power wasted. In this connection it should not be forgotten that the Allen valve enlarges the port opening by a given number of square inches for all cut-offs, while a longer valve travel enlarges it a certain per cent., the number of inches decreasing as the cut-off becomes shorter.

Economy.

Assuming it to be proved that the Allen valve will give greater power than a plain valve, it does not necessarily follow that the economy of the engine will show a corresponding improvement. This will depend on the conditions under which the engine is working. If with the plain valve the conditions are such that the work is done at the most economical point of cut-off, we would not expect any saving in coal by increasing the power; possibly the reverse if the basis of comparison is the pounds of water per indicated horse-power-hour. But if the basis is the cost per ton-mile there can be little doubt that the greater power will secure a saving.

Lead.

Inasmuch as the Allen valve gives a quicker and larger steam admission than the plain valve, it follows that the lead for the former should be less than for the latter. In my opinion it has been the failure to appreciate this fact which has caused many to conclude that the Allen valve has no advantages, but rather the contrary. Not only should the lead for the Allen valve be less than for the plain valve, but it must be if the best results are to be obtained. The smaller lead which the Allen valve requires is a decided advantage in several directions, as will be seen by a study of the following table, taken from Zeuner valve diagrams of a gear having ⅞-in. outside lap, ¼-in. inside clearance, 48⅝ ins. link radius, 5 ins. travel in full gear, and is for 6-in. cut-off:

	Plain valve.	Allen valve.
Lead	¼-in.	5-32-in.
Lead opens at	22⅞ ins.	23⅛ ins.
Maximum port opening...	$^{50}/_{100}$-in.	$^{34}/_{100} + {}^{17}/_{100} = {}^{51}/_{100}$-in.
Release begins at	13⅛ ins.	13⅞ ins.
Compression begins at...	18 "	18⅝ "

If we assume that the Allen port is half as efficient as the port opening at the end of the valve, the Allen valve has increased the steam port opening 20% even after the lead has been reduced nearly 38%. The reduction in lead made possible by the use of the Allen valve has delayed

*Abstract of a paper presented at the Washington meeting of the American Society of Mechanical Engineers.

†Master Mechanic, Denver & Rio Grande Ry., Denver, Colo.

exhaust opening; thus, increasing the period of expansion ¾-in., or 3%, has also delayed exhaust closure ¾-in., or 3%. These results due to the reduction in lead are equivalent to reducing the inside clearance from ¼-in. to 5-32-in. so far as expansion is concerned, and increasing the inside clearance from ¼-in. to 5-16-in. so far as the effect on compression is concerned. There can be no reasonable doubt that these changes introduced by the Allen valve will increase the power of an engine except at very slow speeds, and will favorably affect its economy except when the engine with plain valves is working under the most favorable conditions, which are rare in railroad service.

A PECULIAR GRADE CROSSING.

A novelty in the way of an electric railway and highway crossing is illustrated in a recent number of the "Schweizerische Bauzeitung," in connection with a description of the electric railway recently constructed between Stansstad and Engelberg, in the Canton of Unterwalden, Switzerland.

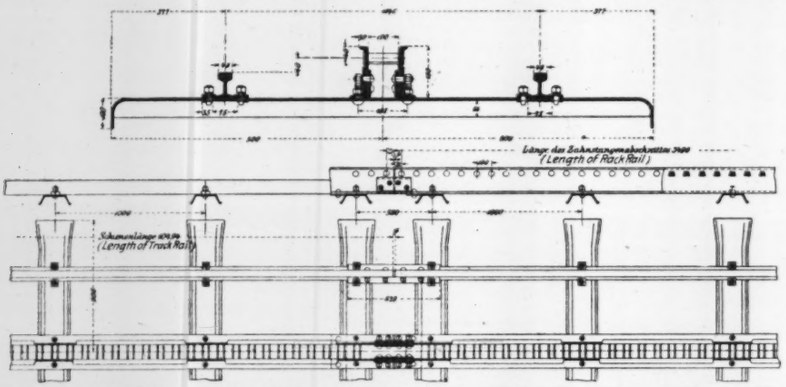
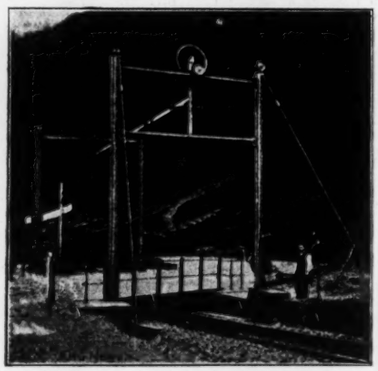


FIG. 1.—DETAILS OF TRACK CONSTRUCTION, SHOWING TYPE OF RACK EMPLOYED.
Stansstad-Engelberg Electric R. R., Switzerland.

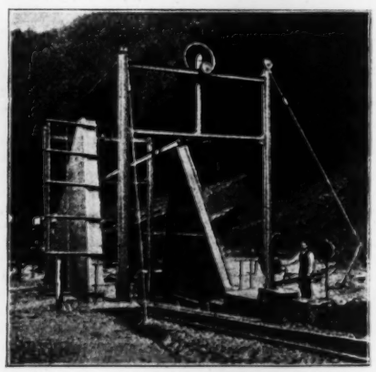
The road is 22½ kilometers (about 14 miles) long, and uses the overhead trolley throughout. In the steeper portions a rack is employed to permit the safe and easy ascent of the grades.

The crossing referred to is a short distance from Engelberg, and occurs at a point where the post road and the railway cross, both on a curve. Owing to the construction of the track, in which an unusually high rack is employed, Fig. 1, it was necessary to have some form of crossing which would prevent the rack filling up with the dust and dirt of the much-traveled post road. It was also desirable to have more head-room than the ordinary height of the trolley wire afforded. The method adopted to accomplish these results is quite clearly shown in Figs. 2 and 3, and is, to say the least, elaborate. Certainly few American engineers would ever devise so complicated an apparatus for so simple a purpose.

Fig. 2 illustrates the principle of the crossing, which consists of two triangular-shaped lift bridges and a movable section of trolley wire. The bridge, when closed, as shown in Fig. 3, just clears the rack of the electric road, and when open it effectually blocks the highway. The raising or lowering of the sections of the bridge is effected by a system of gears operated by an attendant. The movable section of the trolley is raised when the bridge is closed, and lowered when the bridge is opened by a small windlass seen on the post at the right of Figs. 2 and 3.



Bridge Lowered and Trolley Section Raised for Highway Traffic.



Bridge Raised and Trolley Lowered for Passage of Car.

FIG. 2.—LIFT BRIDGE, HIGHWAY ELECTRIC RAILWAY CROSSING.

STATE DRAINAGE WORK IN THE RED RIVER VALLEY, MINNESOTA.

In the Red River Valley in Minnesota the extensive marsh lands and swamps and the excess of soil water have prevented the successful cultivation of large tracts of land; but the state authorities are now successfully overcoming these difficulties by the systematic construction of state-ditches, which are virtually small rivers. From the last biennial report of the State Drainage Commission we obtain the following interesting notes upon this subject:

To better understand the conditions, it should be said that the Minnesota side of the Red River valley is made up of three planes of one watershed—if we can call that a watershed which fails to shed water. All of these planes have a slight drainage towards the north; the same as the Red River itself, which has a slope of about 3 ins. to the mile on the lower 300 miles of its course. These planes are each about 10 miles wide and have a different slope towards the Red River. The one adjacent to the river has a slope sufficient to rid itself of excess storm-water; and it has ample and well-defined water courses, and overflow is uncommon. The eastern, or remote plane has even better drainage, as it is the slope of the bed of old Lake Agassiz, and its streams easily deliver the water to its own western boundary.

The middle section, however, 10 miles wide by 225 miles long, has a natural slope varying from only a few inches to a foot or two per mile; and small streams cannot maintain their course with so slight a fall. The low velocity cannot keep the channel open by natural erosion; and sedimentation, and the growth of vegetation, soon obliterates all traces of a watercourse. In fact, no small streams exist in this middle belt, and the few large ones that cross it are a menace, rather than a safeguard, in time of flood. The small available slope in these larger streams is consumed in bends, and disastrous overflow results from any extra demand put upon them. This middle section must thus dispose of excess water by the slow process of infiltration and evaporation. It accomplishes this to a great extent, thanks mainly to a relatively small rainfall and a deep, rich soil. But in addition to its own rainfall it receives that from an even larger area to the east, through numerous small streams that literally lose themselves by spreading over the prairies of the middle section.

Only a part of this middle belt, however, is really swamp land; when drained it is all alluvial deposit over a clay subsoil, exceedingly fertile and of the finest quality for all-around agricultural purposes, when once drained. It is for the purpose of reclaiming this territory that the state is conducting its drainage work. While the state cannot supply the necessary slope to produce natural rivers, it can cut deep, straight, canals across the belt and thus do away with the velocity-consuming bends and make available the existing slope. As the resulting small velocity of one to three miles per hour is not sufficient to prevent the growth of grass in the bottom of the ditch, this grass must be removed from time to time.

The first attempt to lessen the damage from storm-water in the Red River valley was made about 1879, by Mr. James J. Hill, President of the Great Northern R. R. In all, about 45 miles of ditches were dug by this corporation, generally 3 ft. wide on the bottom with side slopes of 1 on 1½, and with depths varying to meet local conditions. While very few of these ditches connected with any well-defined outlet, they drained the storm-water from the road-bed; were of some benefit to the adjacent land, and they were useful as object lessons to the farmers, by showing them that even small drains were of some service.

In July, 1886, a convention was held at Crookston to formulate some practical plan for the general drainage of this section. It was very properly decided that an accurate topographical survey was needed first, and $10,000 was raised for this purpose. Mr. J. T. Fanning, M. Am. Soc. C. E., of Minneapolis, was appointed the consulting engineer, and Mr. C. C. Elliott had charge of the field work. The plan for relief which these engineers devised called for about 275 miles of main ditch, to cost $750,000. Efforts made in 1887, 1889 and 1891 to secure an appropriation for this work by the state failed; but in 1893 the Minnesota legislature passed a bill creating the Red River Drainage Commission, and $100,000 was appropriated to make a beginning. The commission was organized with Mr. Ezra G. Valentine, chairman, and Mr. O. H. Hoffman, of Minneapolis, was put in charge of the engineering work. Up to this time about 125 miles of main ditch have been dug at a cost of about $250,000; of this sum the Great Northern R. R. contributed $25,000 and the remainder was raised by state appropriattions.

Mr. W. R. Hoag, C. E., secretary and engineer of the present commission, reports that from observations made in June, 1898, one of these average ditches passed at flood tide 320,000 gallons per minute; this is equivalent to carrying away in less than an hour the ordinary all-day rain on one square mile of territory. Mr. Hoag also says that over 3,000 miles of levels were run to secure the data for making a contour map of about 100 townships in the valley. A study of this map has resulted in dividing the area to be treated into about 25 sub-drainage districts, varying in size from 15,000 to 35,000 acres each. The ditches for these are of varying lengths, depths and carrying capacity, to suit the local demands. The cost of these ditches ranges from $1,400 to $6,000 per mile; the commission has had the greater part of the earthwork in these ditches done for about 8 cts. per cu. yd.; and at this price the completed system of main drains would cost about 75 cts. per acre of land directly benefited. The unusual success which has attended the efforts of the commission is largely due to the energy, intelligence and hard work of Mr. Valentine, the late chairman of the commission, who served without compensation, and has been at once the business man-

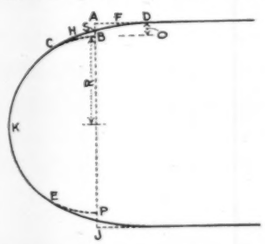
ager, legal adviser and consulting engineer of the commission.

The ultimate success of the undertaking is now assured, and the work of the state is being supplemented by the building of a system of secondary ditches at the cost of the nine counties interested. Polk county has also expended over $80,000 in digging main ditches on the plans laid down by the state engineers, preferring this outlay to the alternative of awaiting new appropriations by the state. The last report of the commission to the Governor of Minnesota states that during the single season of 1897 the ditches fully demonstrated their economic value by saving in crops—which would otherwise have been drowned out—a value exceeding by two or three times the whole amount expended upon them by the state.

THE APPLICATION OF THE RAILROAD SPIRAL TO RACE TRACKS.

By Wm. G. Raymond.*

It is probable that a race track, whether for trotting, running or bicycle use, will be somewhat easier and hence presumably faster if laid out with easement curves where the circular ends join the straight sides, and the railroad spiral affords such a simple and easy method of accomplishing



this as to make its adoption almost certain when its simplicity is realized.

To lay out a track with such easement curves proced as follows: (See Figure.) Instead of laying in the curve with diameter A J, lay in one B K P with a diameter of say 4 ft. less than A J. Bisect A B = O, and establish a point at S on the spiral. With a radius found from

$$L = \sqrt{6 . O . R},$$

and S as a center, describe two arcs cutting the straight side in D and the curve in C. Midway between A and D set over from A D an offset to F equal to 1-16 O, and midway between B and C do the same thing from the curve, locating the point H.

The two ends and three intermediate points are now located on the curve and it can be put in by eye. If other points are wanted they can be located by the following formula:

The offsets from the tangent to the spiral are as the cubes of the distances on the tangent or spiral, measuring from D, and the same offsets are used between C and B from the curve that are used between D and A from the tangent.

In canting the track, find the proper rate of cant for the circular arc of radius R, make the track level at D, give it one-quarter the full cant at F, one-half at S, three-fourths at H and the full cant at C.

It is interesting to note that for a speed of a mile in two minutes, which may be called average bicycle time, the proper elevation per foot of width is given by the simple expression

$$E = \frac{60}{R},$$

while for three-minute time it is given by

$$E = \frac{27}{R},$$

and for 2.30 time it is

$$E = \frac{38}{R},$$

the formulas being approximate in each case and giving the rise per foot of width measured horizontally and not on the slope of the track. It is advisable that the line on which the track is measured, 18 ins. from the pole in bicycle tracks and 3 ft. in trotting tracks, shall be carried around level, the inner part of the track being depressed and the outer raised at the required rate.

The length of the track will be practically that given by measuring the straight sides to A and J and adding the semicircle B K P. The same principles apply to laying out a kite-shaped track.

To indicate the simple application of these methods let an example be assumed.

The distance between the measuring lines of the parallel straight sides of a bicycle track is made say 204 ft. Assume, then, a radius for the end arcs of 100 ft. and mark the curve in. The offset A B in the figure will then be 2 ft. Establish the point midway between A and B, 1 ft. from either. The length S D or S C is given by

$$L = \sqrt{6 \times 2 \times 100} = 34\tfrac{2}{3} \text{ ft.}$$

Mark the points D and C and the quarter points on the straight side and on the curve 17⅓ ft. from D and C, respectively, and set over at these points to F and H, respectively, offsets of

$$\frac{O}{16} \text{ ft.} = \tfrac{1}{8}\text{-ft.} = 1\tfrac{1}{2} \text{ ins.}$$

Strike the curve through the points D, F, S, H and C.

The full cant from the main portion of the circle is for 2 minute time at the rate per foot of

$$C = \frac{60}{R} = \frac{60}{100} = \frac{6}{10} \text{ ft.}$$

rise per foot width. If the track is measured 18 ins. from the pole, then the pole should be lowered $1\tfrac{1}{2} \times \frac{6}{10} = 9\text{-}10$ ft., and the outside raised proportionately.

For the easement curve at the ends make the track level at D, cant it ¼ × 6-10 = 3-20 ft. per ft. width at F, 3-10 per ft. width at S, 9-20 per ft. width at H, and the full amount, 6-10, per ft. width at C, and continue this cant to the beginning of the easement curve on the other side.

*Professor of Geodesy and Road Engineering in the Rensselaer Polytechnic Institute.

THE VIENNA EXPORT ACADEMY, organized Oct. 1, 1898, is a commercial school of an original character. It is under the personal charge of a high official in the Austrian Ministry of Commerce, and its one object is the promotion of Austrian trade. The graduates first act as clerks in exporting and manufacturing firms; there gain practice in some special branch of business; and they are then placed by the Minister of Commerce in some larger foreign firm. Finally, by the joint protection of the Austrian government, the chambers of commerce and the foreign consulate concerned, they are aided to establish themselves abroad in business. The academy course is three years, with tuition fees of $60 per year, and special courses. Besides school instruction, they are taken to home and foreign industrial establishments under expert guides and the Imperial Royal Commercial Museum is at their disposal. Graduates of the higher commercial schools are entered as regular students on the two-year course. Great stress is laid on acquiring the English and French languages, and the general supervision is very strict. In the week, 6 hours are devoted to languages; 4 hours to domestic and foreign law relating to commerce; and 3 hours to practical office work in export, import and factory business. Economics, tariffs, usages of export trade, commercial geography, knowledge of the world's wares and products, are included in the course of instruction.

THE GERMAN-AMERICAN SUBMARINE CABLE surveys, which were begun by the cable-laying steamer "Britannia" some time ago, are nearly completed. The proposed cable lines will start from Emden, Germany, and touch the Azores, and the final landing place of the American end will, it is stated, probably be at Coney Island, near New York. The line when completed is expected to cost about $5,000,000, and the great bulk of the money will be furnished by German investors. The longest stretch of the cable, which will be between the Azores and New York, will measure 2,279 miles. At present the Azores can be reached from the United States only by the way of London and Lisbon. The Commercial Cable Co., of New York, is reported to have an interest in the proposed line.

THE CAPE TO CAIRO TELEGRAPH LINE has been advancing at the rate of 2 miles per day, according to the London "Engineering." This progress must be considered good, when it is remembered that the poles, wires, and other material have to be transported hundreds of miles from the coast, and that a route for the line has to be cleared through dense jungle. The line from the south is now being laid on the plateau between Lake Nyassa and Tanganyika. The country has been surveyed as far as the frontier of the Congo Free-State. A branch line is projected from some point half-way up Lake Tanganyika to Stanley Pool. From Karonga, the most northern station on Lake Nyassa, the telegraph will go in a northwesterly direction towards the south of Lake Tanganyika. It is proposed that the telegraph should run westward of Lake Tanganyika, in the Congo Free-State country, and that it should then enter German territory, enabling it to be continued on the western shore of the Victoria Nyanza. Thence the line would be carried into Uganda; only some 250 miles of German territory would have to be traversed. The surveyors for the company are Mr. Otto Beringer and Mr. Graham. Mr. Beringer is at present in England. When he left he had advanced 220 miles beyond the point which the constructing had reached. Mr. Beringer controls an exploring expedition of 10 whites and 800 to 1,000 blacks. He advances with two whites and 200 blacks. He selects the route which the telegraph has to follow, and he clears a path for it about 15 ft. wide. A second party follows and widens the 15-ft. path to 60 ft. more or less, according to the nature of the country. A third party digs the holes, a fourth fixes the poles, and a fifth stretches the wires. The poles are of iron, and have all been sent out from England. They weigh 160 lbs. each, and are generally 14 ft. high, although higher poles and heavier material are employed for longer spans. When the line has to cross gullies or streams, it is not unusual for the spans to attain a length of 200 to 250 yards.

A SUBMARINE TUNNEL to connect Ireland with England was the subject of a "largely attended meeting of Peers, Commoners, engineers and others" at London, on June 12. Resolutions were adopted in favor of petitioning the government for the tunnel. The length is said to be 25 miles and the estimated cost $60,000,000.

THE WORLD'S PRODUCTION OF PETROLEUM in 1897 was over 5,000,000,000 gallons. The United States produced 2,544,000,000 and Russia 2,281,000,000 gallons, Austria coming next with 88,000,000 gallons and Italy being at the foot of the list with only 762,000 gallons.

THE COAL OUTPUT OF THE UNITED STATES, for 1898, according to the report of Mr. Edward A. Parker, of the U. S. Geological Survey, was 219,835,993 short tons for all kinds of coal, or nearly 10% above the total output for 1897, though the latter was the largest tonnage ever obtained for this country. Great Britain's output for 1898 was 226,287,312 short tons. In the United States the anthracite output for 1898 was 47,515,543 long tons, or 700,000 tons over 1897. The selling value of anthracite coal decreased $3,872,000, while that of bituminous advanced $8,910,000. The Illinois coal product fell off, in 1898, 1,473,459 tons, credited entirely to labor troubles. Pennsylvania, on the other hand, added 10,557,963 tons to her 1897 bituminous output, the total being 65,155,844 tons. West Virginia mined a total of 16,835,119 short tons; Ohio, 14,476,500 short tons; Alabama, 6,553,000 tons; Indiana, 5,000,000 tons. The increasing use of machinery in mining bituminous coal has largely reduced the cost; and bituminous coal, with its products of gas and coke, is competing more and more with anthracite coal for domestic consumption. On the other hand, the anthracite miners are faced with a condition of constant increase in the cost of production, says Mr. Parker.

A CONTRACTORS' ASSOCIATION has been organized at Indianapolis, Ind., under the name of the Indiana Turnpike & Street Contractors' Association, with a capital stock of $100,000. The object is said to be to fight a combination or trust controlling such supplies as brick and sewer pipe, and it is also said that the association may establish brick and pipe works of its own. About 100 firms are represented, and others are expected to join, the number of contracting firms in the state being given as 250 by the "Clay Record," from which the above particulars are taken. The officers are as follows: President, W. C. Dorsey, of Terra Haute; Vice-President, G. W. Dunn, of Frankfort; Secretary, J. F. O'Brien, of Cloverdale; Treasurer, D. H. Fatout, of Indianapolis.

AN APPROPRIATION FOR ANTARCTIC EXPLORATION is asked for in a bill recently sent to the German Reichstag. The bill proposes a grant of 1,200,000 marks ($300,000) in five yearly installments. The expedition is to be accommodated on a single wooden ship, as such vessels are considered to be best adapted for work in the ice and for magnetic measurements. It will leave Germany in the Autumn of 1901, to complete its equipment at Cape Town, and then go via the Kerguelen Islands to Eslabitsch. Attempts will be made to approach as near as possible to the antarctic pole and the magnetic pole by means of sleighs drawn by Siberian dogs and a captive balloon. No one has previously wintered in the region, and it is hoped that the expedition, by doing so, will obtain some valuable results. Dr. von Drygalski, Professor of the Berlin University, has been appointed leader of the expedition, which, it is stated, will probably cooperate with that sent out from England. They will meet, it is expected, in the neighborhood of Termination Island.

BOOK REVIEWS.

AIR BRAKE DISEASES.—By Paul Synnestredt. W. F. Hull Printing Co., Chicago, Ill. Cloth, 5 × 7½ ins.; pp. 127; illustrated.

This is a revised edition of the same author's "Diseases of the Air Brake System," to which has been added an introduction on the principle of the automatic brake and an appendix on the air signal.

THE SHORT LINE WAR.—By Merwin-Webster. New York: The Macmillan Co. 12mo.; cloth; pp. 334; illustrated. $1.50.

This little novel is a story of the fight of two rival sets of capitalists for the control of a railway company. The story is well told, albeit with a certain jerkiness of style; and while the author's purpose is doubtless merely to interest and amuse his reader, it is not hard to read a moral between the lines. Such lawless proceedings in corporation management as are here described are a disgrace to society, and they beget a contempt for law that constitutes a grave danger.

THE SLIDE RULE, A Practical Manual.—By Chas. N. Pickworth; 5th edition, revised and enlarged. Manchester: Emmott & Co., Ltd. 5 × 7¼ ins.; pp. 80; illustrated. 80 cts.

This convenient and well-written little book is a complete account of the uses to which the Mannheim slide rule can be put. Those who appreciate the utility of the slide rule will find the book valuable for reference, since the usual operations, with which they are more or less familiar, are well stated, and new uses are suggested in a clear and simple way.

For those not familiar with this calculating instrument and the saving in time that can be effected by its use, we know of no better description than is given in this treatise.

A TREATISE ON PHOTOGRAPHIC OPTICS.—By R. S. Cole, M. A. First edition. New York: D. Van Nostrand Co. 5¼ × 7½ ins.; pp. 330; illustrated. $2.50.

The author in his preface states that the book is intended "to occupy a middle course between giving too much mathematics and giving none at all." Notwithstanding this, the work appears to us too mathematical to be enjoyed by:

the ordinary photographer, who, while engrossed in picture-making, still finds time for the study of the chemistry, optics and mechanics of it.

Considering the price of the book, there is small excuse for its poorly executed illustrations, many of which sprawl over a full page, when a half or quarter page would show them fully as well.

Notwithstanding these defects, the book will be found a very useful one by students of scientific photography. It is in general clearly written; and the practical rules for the testing of lenses and the chapter on "Exposure, stops and shutters" will interest any photographer who cares to study the scientific principles of his art.

OFFICE OF NAVAL INTELLIGENCE.—War Notes. No. IV.—Sketches from the Spanish-American War. By Commander J. Concluded. Translated from the German. Pp. 28, maps. No. V.—Effect of the Gun-fire of U. S. Vessels in the Battle of Manila Bay, May 1, 1898. By Lieut. John M. Ellicott, U. S. N. Pp. 13; paper; 9 × 6 ins.

No. IV. is the conclusion of the narrative of a German naval officer on the naval battle of Santiago, and the operations in Porto Rico, originally published in the "Marine Rundschau." He reports the condition of Admiral Cervera's vessels after their destruction, and criticises the wisdom of his sortie. No. V. describes the appearance of the Spanish vessels in Manila Bay after the fight, and specifies the effect of the gun-fire upon these vessels. In the four larger vessels evidence was found of 125 hits; two of these ships having 39 and 40 hits respectively. In the ten vessels sunk 141 hits were apparent; of these, 13 were 8-in., 6 6-in., 22 5-in., or larger; 31 6-pdr. and 29 other smaller caliber. These are the hits that can be counted in the burned hulls and upper works; but Lieutenant Ellicott says that the vessels were probably struck by many more shot. The official returns for the Spanish ships show 167 killed and 214 wounded, or 381 in all. One of the most important deductions from this battle is—that at ranges of less than 2,500 yds. gun-shields of cruisers in no sense protect the gun, and insure the destruction of the gun and the gun's crew if struck.

REPORT OF THE CHIEF OF ENGINEERS, U. S. A., for the Fiscal Year Ending June 30, 1898; in six volumes. Washington, D. C. Cloth, 9 × 5½ ins.; total pp. 3,855. Many maps and illustrations.

In the beginning of his report Gen. John M. Wilson, Chief of Engineers, U. S. A., calls attention to the need of an increase in the number of the corps, which now includes 123 officers of all grades. The mass of material contained in these six bulky volumes, and the range of territory covered by the reports, sufficiently and forcibly point out the largely increased duties and responsibilities of the members of this corps. A bill for a gradual increase of 18 officers has been passed by Congress; but this increase seems very modest, especially in view of the fact that some of the Engineer officers are now detailed for duty in Cuba, Porto Rico and the Philippines, while the engineering work in the United States has been largely increased by the events of the past year. These reports cover the detailed operations of the Engineer officers and their civilian assistants, in fortification work, and river and harbor improvements. We have only one criticism to make and that is that some of the many folding plates used are unnecessarily large for the purposes intended. A plan 3 or 4 ft. long is out of place in any octavo book; and by adopting a proper size of letter and figure on the original tracing, proportioned according to well-established rules, the plates could be very much reduced in cost and in dimensions without any loss in clearness, and with a great gain in the handiness of the volumes.

RAILWAY ENGINEERING.—By Cecil B. Smith, M. E., late Professor of Civil Engineering at McGill University; Member Canadian Society of Civil Engineers. Toronto and Montreal: Canadian Engineer, publisher. Cloth; 8¾ × 5¾ ins.; pp. 197; illustrated. $1.50.

We here have presented in book form a series of articles on railway construction originally published in the "Canadian Engineer." The author has had a long and varied practical experience in railway work; and while he quotes freely from the late Mr. A. M. Wellington's "Theory of Location," and from other standard works on this subject, his aim is to serve those who wish to acquire some general information on subjects heretofore separately treated. In the first chapter he deals with fundamental considerations and statistics, chiefly applicable to Canadian railways. Train, curve and grade resistance and their cost, and vertical and horizontal and transition curves are treated in the next two chapters. Under Surveys, we have the organization and methods for making reconnoissance, preliminary and final surveys, and some of the methods of passing obstacles. "Roadbed construction" covers waterways of various types, with designs for such structures and approximate cost, and includes large bridge foundations and the methods for sinking them; wooden trestles are treated at full length as still desirable where wood is abundant and other material unavailable. Foundations on land and in water are separately treated; the various methods are described and the approximate cost is given in many cases. The laying out and measurement of work is illustrated by diagrams and text, and notes are included on the methods of payment and classification of materials, etc. The sixth chapter deals with Canadian railway law, under the Railway Act; and Part II. of the book is devoted to track details. The work, taken as a whole, condenses into a small compass much information that will be useful to young railway engineers.

PRACTICAL CALCULATION OF DYNAMO-ELECTRIC MACHINES.—A Manual for Electrical and Mechanical Engineers and a Text-Book for Students of Electro-Technics, by Alfred E. Wiener, E. E., M. E., M. A. I. E. E. First edition. New York: The W. J. Johnston Co. 6½ × 9¼ ins.; cloth; pp. 683; 375 illustrations; 105 tables. $2.50.

The author in his preface states that he has endeavored to develop an entirely practical treatise on dynamo calculation differing from the usual text-book methods. This is quite true, and the volume may be, in consequence, called unique. It is based upon data and test, records collected by the author from over 200 dynamos of American and foreign make of all sorts and outputs. From a study of this mass of material nearly 500 formulas and conclusions have been drawn and about 100 tables prepared to facilitate the design of continuous current electric generating machinery, along the lines indicated by the author.

To facilitate the practical use of the book the formulas are all so stated that results are obtained in inches, feet and pounds. The tables, however, are in the English and metric systems. As a further help to those using the book, the contents have been arranged in the order of natural sequence—that is, the calculation of the length and size of conductor required for a given output at a certain speed; the arrangement of this conductor upon a suitable armature; the supplying of a magnetic circuit of proper cross-section to carry the magnetic flux required by the armature, and the determining of the field winding necessary to produce the magnetizing force required to produce the desired flux.

It is impossible in the limited space at our disposal to give an adequate idea of the mass of data contained in this work. Some idea may be afforded as to its extent of the work when it is stated that the list of symbols employed in the many formulas require 10 full pages, and includes about 380 separate characters—a point in which it is open to criticism.

Nearly all of the tables are well arranged, and contain data of value which can be used irrespective of the author's formulas, which, by the way, are really very simple, although in some cases they appear at first glance rather startling.

In the preface appears the statement:

Although being intended as a text-book for students and a manual for practical dynamo designers, any one possessing but a fundamental knowledge of arithmetic and algebra will by means of this work be able to successfully calculate and design any kind of a continuous current dynamo.

We do not, however, fully agree with this, for two reasons: First, the calculation and design of electric generators or motors should not be attempted by "any one possessing only a fundamental (elementary?) knowledge of arithmetic and algebra," and, second, while the treatment of the subject in this book is clear and simple, all things considered, a proper understanding and appreciation of the data given requires a considerable amount of theoretical and practical knowledge on the part of the reader. This is not said by way of unfavorable criticism, for we consider this one of the best books ever printed on the subject of dynamo design. In fact, considering the price, the material contained, the character of illustrations, etc., the book well deserves the term unique, and should be in the library of every designer of electrical machinery.

SANITARY ENGINEERING.—A Practical Treatise on the Collection, Removal and Final Disposal of Sewage and the Design and Construction of Works of Drainage and Sewerage, with a special chapter on the Disposal of House Refuse and Sewage Sludge and Numerous Hydraulic Tables, Formulas and Memoranda, including an Extensive Series of Tables of Velocity and Discharge of Pipes and Sewers, Specially Computed by Ganguillet and Kutter's Formula. By Col. E. C. S. Moore, R. E., Author of "Sanitary Engineering Notes," etc., Formerly Instructor in Estimating and Construction at the School of Military Engineering, Chatham. With 534 Illustrations and 70 Large Folding Plates. New York: Longmans, Green & Co. London: B. T. Batsford. Cloth; 7 × 9 ins.; pp. xxvii., 621. Price, $10.

The author has brought together in this volume a vast amount of material on sewerage and house plumbing and considerable regarding sewage disposal. On the disposal of garbage and refuse he says less, but gives a fair review of the subject. The hydraulics of sewerage design are presented fully, with many convenient tables for the solution of hydraulic problems.

Those called upon to devise relief for houses, barracks or institutions which are and for any reason must remain without sewer connections, will find here numerous illustrated descriptions of excreta pails, dry earth and other forms of closets.

One notable feature of the book is the extensive description and illustration of all manner of patented devices, such as traps, ventilators, apparatus for testing plumbing, and others too numerous to mention. The author has perhaps taken more pains to include everything of this sort than to point out the merits and defects of the various articles. But it is often a great convenience to be able to examine all that has been attempted or is current in certain lines, even if thrown upon one's own resources in judging of comparative merit.

Another feature deserving mention is the very full list of illustrations, both in the text and on plates. Most of these are well-executed, or at least clear, but some of the plates are needlessly large, and the matter shown on others might, with proper rendering by the draftsman, far better have been placed in the text. Authors and publishers should learn that in all books, and notably in technical ones, large folding plates are often annoying and time-consuming, besides adding needlessly to the expense of a book and rendering damage or destruction more likely.

About one hundred pages, each, are given to sewage disposal and to the disposal of sewage sludge and household wastes. This is a fair division of space between these subjects and the others treated, but, of course, it necessitates sketchiness of treatment at some points. The review of the latest English attempts to find a cheaper and more available system of sewage treatment will be welcome to many; but American readers will not find much news in the extracts from the special reports of the Massachusetts State Board of Health for 1890. It seems strange that English writers on sanitary topics should stop with these reports, instead of following the subsequent ones to date, in order to learn what has been accomplished at the Lawrence Experiment Station since 1890. Perhaps our cousins do not know that the little State of Massachusetts has continued for ten years to make yearly appropriations of about $30,000 for the study of sewage and water purification, and that the later reports change a few of the earlier conclusions, strengthen others and add many new ones, besides presenting the results obtained in practice at a number of city plants. English writers frequently speak of the work of their countrymen as a continuation of the Massachusetts investigations of 1890, when a slight examination of the later reports of the Massachusetts State Board of Health would show them that the very same thing had been done at Lawrence, perhaps years before.

The author has not only failed to consult the latest Massachusetts reports, but has ignored almost entirely the large amount of information on sewerage and sewage treatment in American books and periodicals. It is only fair to say that this tendency to seldom look beyond one's own horizon is common to most writers in all countries.

The numerous patent devices described in this book have been mentioned above. These apply to sewage treatment, as well as other matters. While many of the patents have been taken out by manufacturers, it seems to be true that English engineers do not have that hesitancy to patent improved methods or machines which is shown by many American engineers of high standing

Most of the adverse criticism we have made relates to matters of more importance to English than American readers, but the size and weight of the volume render it inconvenient for handling by anyone, while the price of $10 for 600 pages is excessive, and will doubtless limit its sale in this country. The book has not the fault of some technical publications, margins suitable for a poet's edition-de-luxe, but the thick, heavy paper makes the volume also thick and heavy and hard to hold in an open position. We are pleased to say, in conclusion, that the paper is of excellent quality and the typography and presswork all that could be asked, while the book, on the whole, is creditable to both author and publisher.